Report of the Regional Technical Consultation for the Development of Code of Practice for Responsible Aquaculture in Mangrove Ecosystems

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FOREWORD

The Mangrove-Friendly Shrimp Culture Project, which the SEAFDEC Aquaculture Department implemented starting in early 2000 with Thailand as the Lead Country for the ASEAN, has develop sustainable culture technology shrimp packages on shrimp farming that are friendly to the mangroves and the environment. Funded by the Government of Japan Trust Fund Program, the Project would be completed in March 2005.

As part of the final phase of the project, it was deemed necessary to re-assess the responsible use of mangroves for aquaculture because it has always been alleged that shrimp culture has lead to the devastation of the mangrove ecosystems. Thus, the Project convened the Regional Technical Consultation for the Development of the Code of Practice for Responsible Aquaculture in Mangrove Ecosystems in August 2004 in order to come up with a Regional Code of Practice.

The Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region, which was adopted during the ASEAN-SEAFDEC Millennium Conference in Thailand in November 2001 specifically promoted the need to conserve and rehabilitate aquatic habitats essential to enhance resources and increase aquaculture production in a sustainable and environment-friendly manner. This provision has been partly tackled by AQD when it developed the Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Aquaculture.

The development of the Regional Code of Practice for Sustainable Use of Mangrove Ecosystems for Aquaculture in Southeast Asia was initiated during the Regional Technical Consultation taking into consideration the social, cultural and ecological aspects of mangrove-friendly aquaculture as stipulated in the Regional Guidelines. This publication includes a paper on Mangroves and Aquaculture in Southeast Asia as well as paper on Mangroves Management and Development in the Philippines. Also included is the Operating Guidelines for Marine Shrimp Culture in Thailand, which serves as model for the Regional Code of Practice. This publication also documents the various codes and guidelines related to aquatic resource conservation developed by the other countries outside the Southeast Asian region.

We hope that this publication serves as a prelude to the Regional Code of Practice for Sustainable Use of Mangrove Ecosystems for Aquaculture in Southeast Asia, which will be published in due time for dissemination to the Southeast Asian region.

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REGIONAL TECHNICAL CONSULTATION FOR THE DEVELOPMENT OF REGIONAL CODE OF PRACTICE FOR RESPONSIBLE AQUACULTURE IN MANGROVE ECOSYSTEMS

Tagbilaran , Bohol, Philippines
25-27 August 2004

INTRODUCTION

Background

The Mangrove Friendly Aquaculture Program, conceived by the Aquaculture Department (AQD) of the Southeast Asian Fisheries Development Center (SEAFDEC) in 1998, refocused its thrust on mangrove-friendly shrimp aquaculture as a response to the growing concern on the loss of mangroves in the region, which has been attributed to the fast development of the shrimp aquaculture industry. Funded by the Japanese Trust Fund, the Five-year Mangrove-Friendly Shrimp Culture Project (MFSCP) implemented in 2000-2004 has as one of its goals, the formulation of the Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems.

SEAFDEC/AQD started implementing the Mangrove-Friendly Shrimp Culture Project in mid-2000 under the ASEAN-SEAFDEC Fisheries Consultative Group (FCG) collaborative mechanism. A series of workshops and training sessions have been conducted in the region to promote the conservation and preservation of the mangroves while transferring developed shrimp culture technologies that are environment-friendly, to the countries in the region.

The first MFSCP workshop, held in Iloilo City, Philippines in 2000, aimed to assess the status of utilization of the region's mangrove areas for aquaculture. The workshop identified problems encountered in such aquaculture activities, and came up with recommendations and strategies on sustainable aquaculture in mangrove areas, most of which were incorporated in the Project Framework. The MFSCP comprises four major activities, namely, pilot demonstration and verification, research, training, and information dissemination. A Mid-Project Workshop was convened in September 2001 in Bangkok, Thailand to review the progress and assess the problems encountered in the implementation of the Project.

The participants in the Regional Technical Consultation for the Development of Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems

The Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region, adopted during the ASEAN-SEAFDEC Millennium Conference in Bangkok, Thailand in November 2001, stipulated the need to work towards the conservation and rehabilitation of aquatic habitats essential to enhance resources and to increase aquaculture production in a sustainable and environment-friendly manner. This was re-emphasized during the Seminar on ASEAN-Japan Cooperation for Sustainable Fisheries through SEAFDEC in Tokyo, Japan in December 2003. Therefore, the need to reassess the responsible use of mangroves for aquaculture became apparent in line with the SEAFDEC efforts to promote rural aquaculture in the region as an integrated rural development strategy.

The Regional Guidelines for Responsible Aquaculture in Southeast Asia established in 2001 include among others, Article 9.1.3 of the Regional Guidelines, which stipulates that:

"(4) Given the importance of mangroves, States and regional institutions should prepare regional guidelines for the responsible use of mangroves for aquaculture. States should ensure coordination among departments, agencies and other units that have jurisdiction and stake in mangroves."

The Regional Seminar-Workshop on Regional Mangrove-Friendly Shrimp Culture in Bangkok, Thailand in June 2003 assessed the extent of implementtation of the ASEAN-SEAFDEC FCG Project on Mangrove-friendly Shrimp Culture including the dissemination of technologies developed through the Project. The Workshop also reviewed policy issues relating to the use of mangroves for aquaculture in the region, which were used as basis in the initial plans for the development of the Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems. Among the recommendations of the June 2003 Seminar-Workshop was the need to develop such Regional Code of Practice in the soonest possible time, hence this Regional Technical Consultation.

Based on the initial efforts made at the June 2003 Regional Seminar-Workshop and making use of the list of initial experts to be involved in the formulation of the Regional Code of Practice as well as the proposed scope and program of work as initial working documents, the Regional Technical Consultation for the Development of the Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems was convened in order to:

1. Come-up with the draft Regional Code of Practice;

2. Establish legal framework for the use of non-land based aquaculture putting more emphasis on the integration of aquaculture into coastal area management;

3. Develop strategies for an integrated approach to development and sustainable use of aquaculture areas such as lakes, rivers, mangroves and other aquatic ecosystems; and

4. Recommend approaches for the rehabilitation of abandoned and unutilized aquaculture facilities in mangrove areas within the context of an ecologically sustainable system.

Forty one particpants coming from Brunei Darussalam, Cambodia, Indonesia, Japan, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam attended the Regional Technical Consultation. Representatives from UNESCO, JIRCAS, the LGUs and NGOs as well as representatives from SEAFDEC, also atended the Consultation.

THE REGIONAL TECHNICAL CONSULTATION

The Regional Technical Consultation for the Development of the Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems was convened by AQD in Tagbilaran, Bohol, Philippines from 25 to 27 August 2004. The SEAFDEC Deputy Secretary General and Trust Fund Program Manager, *Mr. Junichiro Okamoto* gave the Opening Remarks and declared the Regional Technical Consultation open. The Chief of SEAFDEC/AQD and Trust Fund Program Co-Manager for AQD, *Dr. Rolando Platon*, who also served as Chairman of the Regional Technical Consultation explained the rationale for the Consultation and gave a brief background on the Project. He mentioned that the Consultation is an offshoot of the workshops held in Iloilo City, Philippines in 2000 where the Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Aquaculture was drafted, the output of which was published in 2001. He also informed the participants that a technical committee was formed at AQD to prepare the first draft of the Regional Code of Practice, which served as one of the working documents for the Regional Technical Consultation.

SEAFDEC Deputy Secretary General and Trust Fund Program Manager, Mr. Junichiro Okamoto (right) with AQD Chief, Dr. Rolando R. Platon (left) at the opening of the Regional Technical Consultation

In his Message, the SEAFDEC Council Director for the Philippines and the Philippine Undersecretary of Agriculture for Fisheries, *Cesar M. Drilon, Jr*. thanked the Government of Japan for the financial support in the MFSCP and specifically for the conduct of the Regional Technical Consultation. He expressed his appreciation to the participants for their inputs in the draft Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems. He recalled the series of regional technical consultations that were convened by AQD in 2000 and 2001 to draft the Code of Conduct for Responsible Fisheries: Responsible

SEAFDEC Council Director for the Philippines and DA Undersecretary for Fisheries, Cesar M. Drilon, Jr. (right) giving his Message for the Consultation participants (left)

Aquaculture, which he also participated in and he commended AQD for its efforts to prepare a Regional Code of Practice which is now focused on responsible aquaculture in mangroves. He lamented the sorry state of the mangroves in the Philippines and expressed confidence that the outcome of the Consultation will not only save the remaining mangroves in the region but may also rehabilitate and hopefully bring this resource back to its former state.

Mangrove-Friendly Aquaculture Initiatives

The ASEAN-SEAFDEC Mangrove-Friendly Shrimp Culture Project implemented by SEAFDEC/AQD was presented in brief by SEAFDEC/AQD Chief *Dr. Rolando R. Platon*. Dr. Platon discussed the progress of the verification activities of the mangrove-friendly shrimp culture project being implemented in the Philippines, Thailand, Vietnam, Cambodia, Malaysia and Myanmar. He noted that the activities also include Research, Training, and Information. The representatives from organizations attending the Consultation presented their respective organization's initiatives on mangrove-friendly aquaculture. The representative from Japan International Research Center for Agricultural Sciences (JIRCAS), *Dr. Yoshimi Fujioka* presented the initial results of the JIRCAS Project on Sustainable Production Systems of Aquatic Animals in Brackish

JIRCAS Representative, Dr. Yoshimi Fujioka (middle) presenting the initial results of JIRCAS mangrove project implemented in Thailand. Also in photo are MFRDMD Representative, Mr. Zulkifli Talib (left) and UNESCO Representative Mr. Makoto Ikeda (right)

Mangrove Areas: Role of Benthic Organisms as Food for Marine Resources, which is implemented by JIRCAS in Thailand. Dr. Fujioka determined the role of benthic organisms as food of Marine resources and compared the potentials of close and recirculting systems to purify shrimp farm waste water.

The Regional Technical Director for Research and Development of the Philippine Department of Environment and Natural Resources (DENR)-Region VII, *Dr. Dioscorro M. Melana*, presented the outcome of a case study on the Mangrove Reforestation in Barangay Banacon, Banacon Island, Getafe, Bohol, Philippines. Initiated by the late Mr. Eugenio Paden, the Banacon Mangrove Reforestation Project now covers about 410 ha surrounding an area of about 15 ha of dry land.

Left photo: DENR Region-VII Director Dr. Dioscorro Melana (left) presenting the Banacon Reforestation Project Case Study, assisted by Ms. Emma Melana (right).
Right photo: Mr. Teodorico Barral, of the DENR-VII Coastal and Marine Management Division, also provided additional information regarding the Banacon Mangrove Reforestation Project

International/Regional Guidelines and Codes

Representing the AQD Technical Committee for the Code of Practice, *Dr. Jurgenne H. Primavera*, provided some information on mangroves in relation to sustainable aquaculture. She cited some indices of mangrove status and health based on an ASEAN Manual, and gave examples of action points for aquaculturists as basis for formulation of national aquaculture framework. She summarized the various international and regional Codes and Guidelines related to responsible aquaculture and mangrove conservation that can be used as basis for the formulation of the Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems. She focused on the following Codes: the 1997 FAO Technical Guidelines for Responsible Fisheries; the 1999 Codes of Practice for Responsible Shrimp Farming of the Global Aquaculture Alliance emphasizing on Best Management Practices; the 1999 Thai Code of Conduct for Responsible Shrimp Aquaculture: Good Management Practices; the 2000 Bangkok Declaration and Strategy specifically Article 3.5 which stipulates the need to develop and adopt policies and practices that ensure environmental sustainability; the 2000 Code of Practice for Sustainable Shrimp Farming of the Philippines, which encourages responsible and sustainable development and management practices for the preservation of mangroves and the sustainability of aquaculture; the 2001 Environmental Code of Practice for Australian Farmers; the 2001 SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia – Responsible Aquaculture; and the 2004 Code of Conduct for the Management and Sustainable Use of Mangrove Ecosystems developed by the World Bank and the ISME.





AQD's Dr. Jurgenne Primavera (top left photo), presenting some information on mangroves in relation to sustainable aquaculture and the various international and regional Codes and Guidelines related to responsible aquaculture and mangrove conservation that can be used as basis for the formulation of the Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems. Other photos show the participants in the Regional Technical Consultation

Preparation of the Draft Regional Code of Practice

Dr. Jurgenne H. Primavera also briefed the participants on how the first draft of the Code of Practice was prepared, specifically using the consolidation of various international and regional guidelines and codes related to mangroves and sustainable aquaculture as basis. She explained the expected output of the Workshop, which is the draft Regional Code of Practice and exhorted the participants to share their knowledge and provide inputs as it was deemed necessary that the participants reflect their respective concerns in the draft Code of Practice.

Adoption of the Draft Regional Code of Practice

After the Workshop, the draft Regional Code of Practice was developed and adopted on 26 August 2004. Also adopted was the Future Plan of Action that included discussion and consultation with respective governments on the draft Code. The participants were advised to send more comments on the draft Regional Code of Practice to SEAFDEC Aquaculture Department not later than December 2004 as the Code would be finalized in early 2005. The Code will be printed in final format in mid-2005.

FIELD TRIP

On the last day of the Regional Technical Consultation, the participants visited the Banacon Mangrove Reforestation Project in Banacon Island, Getafe, Bohol, the biggest mangrove reforestation project in Asia. The project was started in 1957 by the late Mr. Eugenio Paden and because of his initiatives, he was given the DENR Likas-Yaman Award in 1991 and the Outstanding Tree Farmer Award in 1991 by FAO in Bangkok, Thailand.

Banacon Island had 196 households in 2000 and doubled in 2004. The community is dependent on the mangrove plantation for firewood, poles and other timber construction materials needed for their dwellings, and also on the marine resources in the area such as fish, shells, crabs and other mollusks and crustaceans for food. In 1999, the community started seaweed culture along the mangrove highway and foot trails in the mangrove plantation area. During the field trip, the participants experienced cruising the 'mangrove highway by boat' with the vast mangroves covering both sides of the so-called mangrove highway.

The field trip also took the participants to Bohol's pride – the Chocolate Hills even if the hills looked green because of the rains. The long stretch of Nipa plantation in Calape and along the Loboc River where the famous tarsiers thrive, is the source of livelihood by Boholanos. Most women can make seventy thatches of nipa leaves per day while men produce tuba from its sap.

Regional Technical Consultation participants during their visit of the Banacon Mangrove Reforestation Area




















FUTURE PLAN OF ACTION

The Participants Agreed on the following Plan of Action

September-November 2004

- Discuss draft Code of Practice with respective governments, the private sector, fishfarmers, other stakeholders in coordination with mangrove-aquaculture core experts (identified during the June 2003 Mangrove Workshop)
- Country Representatives collate inputs for submission to AQD as the coordinator for the development of the Regional Code of Practice

December 2004

- Deadline of submission to AQD of inputs for the draft Code from country representatives and mangrove-aquaculture experts

January-February 2005

- Consolidationn of additional inputs

March-May 2005

- Circulation of final draft Code of Practice for information by all country experts
- Printing of the Regional Code for dissemination to member countries
- Translation of the Regional Code into the national languages of the region

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MESSAGE

UNDERSECRETARY CESAR M. DRILON, JR.

Undersecretary for Fisheries
Department of Agriculture
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Good afternoon. It is really good that this Consultation is held here in Bohol because Manila is experiencing heavy rains right now. Bohol is a beautiful place and reports say that it is now the number one tourist destination in the country, but people in Panay would like to disagree this because we still believe it's Boracay.

I am happy to note of the response of the member countries of SEAFDEC and other organizations to the call of the Aquaculture Department for the development of the Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems. Just to recall, ASEAN and SEAFDEC member countries realizing the contribution of the shrimp industry to the region's economy, implemented in 1999 the project on the Promotion of Mangrove-Friendly Aquaculture in Southeast Asia. The project is under the ASEAN-SEAFDEC Fisheries Consultative Group (FCG) collaborative mechanism.

It is worth mentioning that Japan has been very supportive of the projects of SEAFDEC and still continue to provide financial assistance through the Government of Japan Trust Fund Program of its Fishery Agency. During the 22nd SEAFDEC Program Committee in 1999, it was recommended that AQD refocus this collaborative project to emphasize on mangrove-friendly shrimp culture. Thus, the revised framework of the project was approved during the 32nd SEAFDEC Council Meeting, hence the implementation of the Mangrove-Friendly Shrimp Culture Project. The project has four major activities, verification and pilot demonstration, research, training, and information dissemination.

SEAFDEC has been implementing the project on the Regionalization of the Code of Conduct for Responsible Fisheries that focuses on regionalizing the global FAO Code of Conduct for Responsible Fisheries in order to make the global Code applicable in this region. Thus, the SEAFDEC Aquaculture Department was tasked to regionalize the Technical Guidelines for Aquaculture Development of the global Code, the output of which, is the Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Aquaculture which was published in 2001.This Regional Guidelines call for the need to develop the Regional Code of Practice for Responsible Aquaculture in Mangrove Areas.

It must be recalled that the approval by the SEAFDEC Council of the Resolution on the SEAFDEC Strategic Plan led to the forging of the collaboration between SEAFDEC and ASEAN through the ASEAN-SEAFDEC Fisheries Consultative Group. The SEAFDEC Strategic Plan stipulates the need for SEAFDEC and ASEAN to work together in order that mutual benefits could be derived from the member countries. The Mangrove-Friendly Shrimp Culture Project is one of the projects under the FCG collaborative mechanism.

The implementation of projects with regional focus was enhanced during the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium: "Fish for the people" in November 2001. Its output includes among others, the Resolution and Plan of Action on Responsible Fisheries for Food Security for the ASEAN Region, thus the implementation of aquaculture projects in a responsible and sustainable manner. Many developments followed after the Millennium Conference, and in all conferences, the need to conduct aquaculture in an environment-friendly manner has always been emphasized.

We are here in Tagbilaran City, the island of Bohol to make sure that our shrimp aquaculture is not in contradiction with the conservation of our mangroves, and taking note that shrimp aquaculture has been alleged to have led the massive destruction of mangroves in this region. True or not we still cannot confirm. But this time, let us make sure that our shrimp aquaculture should be friendly to the mangrove ecosystems and the environment. I hope for the success of this Consultation. My special gratitude to the Government of Japan for its continued support in this project.

MESSAGE

MR. JUNICHIRO OKAMOTO
Deputy Secretary General
SEAFDEC Secretariat

The Undersecretary of Department of Agriculture, Mr. Cesar Drilon; Jr., Representatives from JIRCAS, UNESCO, the Department of Environment and Natural Resources-Region VII and the Bureau of Fisheries and Aquatice Resources-VII, distinguished guests and participants; my colleagues; ladies and gentlemen,

It is indeed an honor for me to offer some words on this occasion of the opening of this Regional Technical Consultation for Code of Practice for Responsible Aquaculture in Mangrove Ecosystems in Southeast Asia.

As it is widely recognized, aquaculture has been playing very important and various roles in the national economic development in Southeast Asia such as increasing fisheries production, rural development, rectification of poverty, creation of employment and so on. Among the aquaculture, shrimp aquaculture is said to be one of most successful sub-sectors in the region. However, when we recall the history of development in shrimp aquaculture, this important sub-sector of aquaculture had faced serious criticism raised by international environmental groups, because some destructive practices such as demolishing mangrove forestry were sometimes reported in the progress of development and expansion of aquaculture in the region.

Although most losses of the mangrove forestry in the region cannot be solely attributed to aquaculture development, it was recognized that there is a need to appropriately address this criticism. It is therefore important to come up with a Regional Code for this region that could address increased production with focus to some extent on international market, as well as for sustainable development of aquaculture co-existing with local coastal communities where food supply and livelihood rely on healthy environmental ecosystems.

In this connection, SEAFDEC/AQD in collaboration with Thailand as the lead country for the ASEAN started the Project on the Promotion of Mangrove-Friendly Aquaculture in 1999 under the auspices of the Japanese Trust Fund Scheme. Since then, SEAFDEC has implemented various research activities under this project, and has accumulated useful knowledge and information for promoting mangrove-friendly aquaculture, especially shrimp aquaculture. SEAFDEC has already obtained many useful information, knowledge and technologies to promote mangrove-friendly shrimp aquaculture technology in the region.

This year 2004 is the last year of the project, and we have to put together various outcomes into the results of the Project. I believe that the proposed "Code of Practice for Responsible Aquaculture in Mangrove Ecosystem in Southeast Asia" which will be deliberated in this Technical Consultation must be one of final fruits of the Project to guide the people who engage in aquaculture especially in shrimp culture as well as the aquaculture policy managers in their plans and programs.

Regarding responsible aquaculture, SEAFDEC has already developed the "Regional Guidelines for Responsible Aquaculture in Southeast Asia" in cooperation with SEAFDEC member countries and relevant institutions in 2001. Thus, the proposed "Code of Practice for Responsible Aquaculture in Mangrove Ecosystem in Southeast Asia" may be placed in specific part of "Regional Guideline for Responsible Aquaculture in Southeast Asia".

Ladies and Gentlemen, I understand that the major purpose of this Regional Technical Consultation lies in reviewing the outcomes of research done by the project in the past as well as deliberation of draft of "Code of Practice" because the Code should be endorsed by scientific and rational evidence in order for stakeholders to understand the value of proposed "Code of Practice".

I would like you to carefully deliberate and constructively contribute to the finalization of the proposed "Code", because once officially adopted, the "Code" would be a kind of regional guideline to SEAFDEC and ASEAN member countries.

Lastly, I wish to declare the Consultation open and wish for the success of the Regional Technical Consultation.

PROGRESS OF THE MANGROVE-FRIENDLY SHRIMP CULTURE PROJECT

As of August 2004

ROLANDO R. PLATON
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INTRODUCTION

The Aquaculture Department (AQD) of the Southeast Asian Fisheries Development Center (SEAFDEC) implemented in 1998 a five-year Mangrove-Friendly Aquaculture Program covering the culture of various organisms (fishes, crustaceans and mollusks) that could have effects on the mangroves. Upon the recommendation of the 22nd SEAFDEC Program Committee in 1999, the Program was revised to focus on the effects of shrimp culture on mangroves and was placed under the FCG collaborative mechanism.

Thus, starting in early 2000 the Program on the Promotion of Mangrove-Friendly Shrimp Aquaculture in Southeast Asia: Mangrove-Friendly Shrimp Culture Project was implemented giving due focus on shrimp and adopting the major approaches, namely verification and pilot demonstration, research, training, and information dissemination.

The improved practices in shrimp culture in Thailand and in the Philippines served as basis for the technology verification and demonstration activities. These experiences were documented in the form of state-of-the-art manuals.

MANGROVE-FRIENDLY SHRIMP CULTURE PROJECT

The Mangrove-Friendly Shrimp Culture Project (MFSCP) aims to develop sustainable culture technology packages on shrimp farming that are friendly to mangroves and the environment, and to disseminate such packages to the region through actual demonstration and training. MFSCP includes verification and pilot demonstration, research, training and information dissemination activities. Verification and pilot demonstration have been conducted in Thailand, the Philippines, Vietnam, Myanmar, Cambodia, and Malaysia.

Research activities have been conducted at AQD to further refine mangrove-friendly shrimp culture technologies that have been carried out by AQD as well as in other countries such as Thailand. Training sessions which are either formal session at AQD or on-site in specific countries have been programmed in order to hasten the transfer of developed technologies. The training sessions include practical work and field visits to successful mangrove-friendly shrimp operations. In addition, skills development sessions have also been conducted at the pilot project sites. As part of information dissemination, manuals and other information materials have been published and disseminated to the region. The Manual on *Best Management Practices for Mangrove-Friendly Shrimp Farming*, published in 2003 is being translated into major languages in the region. In order to assess the extent of implementation of the Project, seminar-workshops have been convened by the Project. Reports on the seminar-workshops have been submitted to the SEAFDEC and ASEAN member countries. A mangrove webpage, **www.mangroveweb.net** has been operational since 2001. The webpage includes information about the Project, mangroves in general and mangrove resources in the region as well as some information on shrimp culture. Initial report on the project was presented during the Regional Seminar-Workshop on Mangrove-Friendly Shrimp Aquaculture held in Bangkok, Thailand in June 2003.

Philippines: verification and refinement of intensive shrimp culture techniques

Activities to verify and demonstrate the low/partial discharge and closed recirculating systems for environment-friendly shrimp farming in different climatic and environmental conditions in the Philippines will be continued until the end of the Project in March 2005. The project sites are located at AQD's Dumangas Brackishwater Station, BFAR Demonstration and Training Centers (Batangas, Bohol, Lanao del Norte), and in ponds of the private sector.

Songkhla, Thailand: Integrated Physical and Biological Technologies for Water Recycling in Shrimp Farms

Activities to evaluate the Integrated Physical and Biological Technologies for Water Recycling in Shrimp Farms were implemented at the Coastal Aquaculture Research Center in Songkha, Thailand.

Chantaburi, Thailand: Impact Assessment of Seawater Irrigation System for Intensive Shrimp Farming

Activities to assess the impact of the Seawater Irrigation System for intensive shrimp farming were implemented at the Kung Krabaen Bay Fisheries Development Study Center in Chantaburi,Thailand.

Surat Thani, Thailand: Assessment of effluents from shrimp farming in mangroves and coastal resources (commercial scale)

This study was originally implemented in Phuket, Thailand. However, due to the new focus of the site in Phuket, the study was transferred to Surat Thani and the focus is on the commercial scale shrimp farming.




Vietnam: Verification of semi-intensive shrimp culture techniques

Activities to adopt semi-intensive shrimp farming were conducted in Cat Hai District, Hai Phong, Vietnam. until 2003. Selection for another site in southern Vietnam was undertaken.

Myanmar: Verification of semi-intensive shrimp culture techniques

Activities to adopt semi-intensive shrimp farming were conducted in Kyauktan, Yangon, Myanmar.


Cambodia: Verification of semi-intensive shrimp culture techniques

The technology validation run was conducted using a privately owned 1.0 ha pond located at Kabalromeas, Tropiang Saingke Commune, Kompot, Cambodia. The activity was however, aborted in March 2004 because of technical constraints.

The Project's Pilot Demonstration Site in Cambodia

Malaysia: Verification of semi-intensive shrimp culture techniques

Activities to adopt semi-intensive shrimp farming at Johor Bahru, Malaysia was conducted from September 2004 to March 2005.

RESEARCH

Nutrient cycles in intensive shrimp ponds

Conducted at AQD's Dumangas Brackishwater Station in the Philippines, the activity studied the nutrient dynamics, environmental impacts and waste inputs resulting from an integrated closed recirculating intensive farming system. A quantitative estimate of the physical and biological processes of nutrients from shrimp ponds versus treatment ponds has been established.

Capacity of mangroves to process shrimp pond effluents

The performance of constructed mangrove wetland (CMW) and natural and impounded mangrove wetland (IMW) in treating aquaculture waste was evaluated. Results provided evidence that mangroves can remove significant levels of nitrogen and solid wastes from shrimp pond effluents.

Evaluation of probiotics and waste digesters used in the grow-out of tiger shrimp, *Penaeus monodon*

The study aims to assess the use of waste digester to progress mineralization or bioremediation and probiotics for bioaugmentation and control of luminous bacteria.

Economic studies on mangrove-friendly shrimp farming

(1) Philippines

ment-friendly shrimp farming in mangrove
es and improvement of mangrove functional
stems for intensive culture and bio-filtering
ed to contribute to the knowledge of policy
ystems.

mangrove or environment-friendly shrimp
ation on the effectiveness and benefit to the
pared with other shrimp culture farms in the

TRAINING

Formal and On-site Training

Training sessions, either formal at AQD's Tigbauan Main Station in Iloilo, Philippines or on-site in specific host countries, are conducted in order to hasten the transfer of developed technologies. The training sessions at AQD include practicals on actual pond grow-out culture at AQD's Dumangas Brackishwater Station also in Iloilo, Phlippines as well as field visits to successful mangrove-friendly shrimp operations. In addition, skills development sessions have also been conducted at the pilot project sites, to disseminate the technologies developed to the local communities near the pilot project sites.

Four formal training sessions have been conducted under the MFSCP. The first session was from 17 September to 5 October 2001 with 9 participants from ASEAN member countries. The resource persons were from the Department of Fisheries of Thailand and from AQD. A field trip to various project sites in Thailand was conducted with the collaboration of the Department of Fisheries of Thailand. The second session was conducted from 7 July to 27 August 2002 with 10 participants. The resource persons were from the Department of Fisheries of Thailand and from AQD.

The third formal training session was on 23 October-11 November 2003, with nine participants with resource persons provided by AQD. The fourth session was conducted from 21 October to 9 November 2004 with eight participants from Cambodia (1), Indonesia (1), Philippines (2), Malaysia (1), Myanmar (1), Thailand (1), and Vietnam (1).

On-site training sessions on mangrove-friendly shrimp aquaculture have also been conducted in Hai Phong, Vietnam in 2001; in Yangon, Myanmar in 2002; in Binh Dinh, Vietnam December 2004; and in Sihanoukville, Cambodia also in December 2004.

Workshops have also been conducted in order to monitor and assess the progress of activities of the Project: the Planning Workshop on Mangrove-Friendly Shrimp Culture Project, Iloilo City, Philippines, 12-13 May 2000; Mid-Project Workshop on Mangrove-Friendly Shrimp Culture Project, Bangkok, Thailand, 3-4 September 2001; Regional Seminar-Workshop on Mangrove-Friendly Shrimp Aquaculture, Bangkok, Thailand, 24-27 June 2003; and the Regional Technical Consultation for the Development of Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems, Tagbilaran, Bohol, Philippines, 25-27 August 2004.

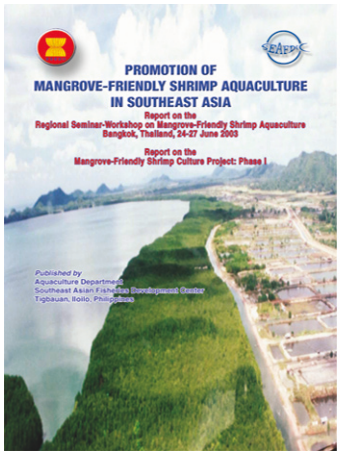
INFORMATION

Translation of Manual on Best Management Practices for Mangrove-friendly Shrimp Farming

Translation of the Manual into Bahasa Indonesia, Filipino, Thai, Vietnamese, and Burmese was started in late 2004. Translation of the Manual into Khmer is also being considered.

Promotion of Mangrove-friendly Shrimp Aquaculture in Southeast Asia

Published in February 2004, the publication includes: (1) Report on the Regional Seminar-Workshop on Mangrove-Friendly Shrimp Aquaculture (Bangkok, Thailand, 24-27 June 2003); and (2) Report on the Mangrove-Friendly Shrimp Culture Project (Phase I).



Mangrove website

The mangrove webpage, **www.mangroveweb.net** has been in operation since 2004.

Other information materials

Other information materials on mangrove-friendly aquaculture (to be compiled as Information Tips) are being produced.

FUTURE ACTIVITIES

Regional Technical Consultation for the Development of the Code of Practice for Responsible Aquaculture in Mangrove Ecosystems

The Regional Technical Consultation for the Development of the Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems was convened by AQD in order to: (1) come-up with the draft Regional Code of Practice; (2) establish legal framework for the use of non-land based aquaculture putting more emphasis on the integration of aquaculture into coastal area management; and (3) develop strategies for an integrated approach to development and sustainable use of aquaculture in mangroves and other aquatic ecosystems.

The forty-one participants representing the SEAFDEC-ASEAN Member Countries and regional organizations as well as from SEAFDEC in the Regional Technical Consultation are expected to work together to come up with the final draft Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems. The first draft developed during the Consultation has been circulated to the SEAFDEC and ASEAN member countries for comments. The final Code will be published in mid-2005.

Other Activities

Other Project activities shall mostly be wrapping up of the ongoing activities until mid-2005. In addition, the final Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems will be printed, and the End-of-Project Workshop is planned to be convened in mid-2005.

MANGROVES AND AQUACULTURE IN SOUTHEAST ASIA

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INTRODUCTION

The history of brackishwater pond culture in the Philippines and elsewhere in Southeast Asia has been associated with mangrove loss because in earlier times, the larger society has viewed mangroves and other wetlands as wastelands to be developed. In a proactive move to address environmental concerns over shrimp aquaculture, the SEAFDEC Council in 1999 mandated the development of environment-friendly shrimp culture and the build-up of expertise in mangroves.

This paper reviews the status of mangroves and their conversion to culture ponds in Southeast Asia, and the environmental impacts of aquaculture, aside from habitat loss. To improve the sustainability of brackishwater aquaculture, recommendations include an inventory of mangrove and pond culture areas in the region, zonation of mangrove areas within the context of integrated coastal zone management, aqua-silviculture and environment-friendly aquaculture, rehabilitation of degraded mangroves, and enforcement of existing laws including the buffer zone/mangrove greenbelt requirement.

MANGROVES

Over the centuries, mangrove systems have contributed significantly to the well-being of coastal communities through their provision of a wide array of goods and services. The latter, also referred to as amenities, include coastal protection from typhoons and storm surges, erosion control, sediment trapping, nutrient supply/recycling, wildlife habitat, and nurseries. Mangrove goods or products come from forests and fisheries. Harvests from the former include timber (for dwellings, construction, fences, furniture, boats, fishing poles), firewood, tanbark for dyes, fibers and ropes, corks and floats, mats and paper. Mangrove plants also yield honey, vegetables and alcoholic beverages; mangrove extracts rich in gums, glues, steroids, alkaloids, flavonoids, saponins and tannins are widely used as medicines, e.g., antiseptics, analgesics, for asthma, boils, diabetes, hepatitis, leprosy, malaria, rheumatism, skin diseases, tumors, ulcers and other ailments (Bandaranayake 1998; Primavera et al., 2004).

Among fisheries products are fish, crabs, prawns, mollusks and other invertebrates used mainly for food. A positive relationship between fish/shrimp nearshore catches and mangrove area has been documented for Indonesia, Malaysia and the Philippines (see references in Primavera, 1995). Mangrove-associated fish, crustaceans and molluscs contribute 21% (1.4 million tons) yearly to the inshore capture fisheries in the ASEAN region (Singh et al., 1994). Mangrove-associated fish contribute around 30% (1.09 million tons) of annual finfish resources excluding trash fish, while mangrove-dependent prawns provide almost 100% (0.4 million tons valued at US$1.4 billion) of total prawn resources in ASEAN. Because there is little evidence for the trophic subsidy or 'outwelling' hypothesis that exported mangrove detritus enhances primary productivity offshore (Lee, 1995), the mangrove-fisheries connection may therefore lie in the nursery function through provision of food and shelter from predation (Hatcher et al., 1989) and the lateral trapping or retention of planktonic prawn larvae in mangrove swamps (Chong, 1996).

The latest global estimate of mangroves is 15 million ha as of 2000, of which a third is found in Southeast Asia (Wilkie and Fortuna, 2003; Fig. 1). This drop from 18 million ha in the early to mid-1990s (Spalding et al, 1997) shows a drastic mangrove decline worldwide within the last few decades. The anthropogenic causes of such loss include overexploitation by coastal communities and conversion to settlements, tourist resorts, agriculture such as rice and coconut fields, salt beds, industrial activities and brackishwater aquaculture.

AQUACULTURE

Aquaculture now provides a third of total fisheries production compared to only 16% in 1991. Globally, aquaculture produced a total of 51.4 million mt valued at US$60 billion in 2002 with more than 90% from Asia (FAO, 2002). Freshwater fish contributed 47.7% of volume, followed by mollusks (22.9%), plants (22.6%) and crustaceans (4.2%). land-based ponds and water-based pens, cages, longlines and stakes in brackishwater and marine habitats provided 55.3% of 2002 production; freshwater habitats contributed 44.7%. Table 1 matches commodities to their respective production system (e.g., ponds and pens) and habitat.

But the phenomenal growth of aquaculture in recent years has been associated with ecological problems and social conflicts. Environmental impacts are salinization of soil and water, loss of bycatch in wild seed and broodstock collection; introduction of exotic species, spread of parasites and diseases, interactions with wildlife, displacement of wild populations, genetic effects, use of chemicals and antibiotics, dependence on fishmeal and fish oil, and release of aquaculture wastes and coastal pollution (Naylor et al 2000; Primavera 1998). Foremost among the negative ecological effects is habitat loss or modification when intertidal mangroves are cleared for ponds and cages/pens are installed above subtidal seagrass beds and sediment communities. Early support from external development agencies such as the International Bank for Reconstruction and Development and the Asian Development Bank facilitated mangrove conversion to culture ponds (Siddall et al., 1985; Primavera, 1993).

Conventional economic analysis of mangrove goods and services generally cover only products that are traded, and ignore nonmarketed services such as coastal protection (Hamilton and Snedaker, 1984). Reviews of published valuation data reveal a range of US$10-4,000/ha/yr for forestry products (Radstrom, 1998) and US$775-11,282/ha for fishery products (Ronnback, 1999). The economic rent of Philippine mangroves converted into aquaculture ponds has been estimated at US$20-130/ha/yr (~PhP520-3,400) depending on cultured crop, planning horizon and discount rate (Evangelista, 1992). But the fishpond lease agreement fee (FLA) for government-owned ponds has remained at PhP50/ha/yr since the 1950s — such low fees underprice the rights to harvest public forests and induce mangrove conversion to ponds, but do not penalize low pond production (World Bank, 1989). After the Revised Fisheries Code was passed in 1998, the Department of Agriculture-Bureau of Fisheries and Aquatic Resources set graded increases for the FLA fee to reach more commensurate levels of PhP1,000/ha/yr by 2004. The lack of implementation of the new fees due to a complaint filed by the aquaculture industry with the courts reflects a lack of political will.

Elsewhere in the region, Sathirathai (1997) compared the benefits from an area comprising 640 ha shrimp ponds + 400 ha mangroves in Tha Po Village, Surat Thani, Thailand. Considering products from forests and fisheries as well as social benefits of coastal protection, shoreline stabilization and carbon sequestration, he concluded that mangrove conversion to commercial shrimp farms was economically viable only for private persons but not for society as a whole. Analysis revealed that the intact mangrove forest had total economic value ~70% higher than when converted to a shrimp farm (~$60,000/ha vs $16,700/ha).

Calculations showed $3,735/ha maximum Net Present Value for a shrimp farm which is lower than $4,116/ha maximum economic value (including $666/ha fisheries, $2,991/ha coastal protection, $170/ha direct uses but excluding other uses and non-use values) when mangroves were retained.

WHAT CAN BE DONE

To become sustainable, the development of aquaculture must change its sectoral approach to one of integration within the coastal zone. Steps towards attaining sustainability include an inventory of pond and mangrove areas in the region followed by mangrove area zonation, mangrove rehabilitation, environment-friendly aquaculture, and enforcement of existing laws.

Law enforcement

Numerous laws and regulations have been promulgated by countries in the region to protect remaining mangrove areas and mitigate widespread deforestation. In the Philippines, these include criteria for permanent forests (areas for shore/riverbank protection and those bordering islands, game and bird sanctuaries); guidelines for mangrove development into fishponds or rehabilitation or reversion of unutilized/abandoned ponds back to

mangrove forest; and legal property instruments such as renewable 25-year Community Forest Management Agreements and Mangrove Stewardship Agreements (Primavera et al, 2004). The latter allow selective harvest of mangrove products for livelihood, thereby encouraging community participation and ensuring local responsibility and sustainability of mangrove rehabilitation. This grant of tenure has been critical in the success of community-based mangrove replanting programs by legitimizing the *de facto* claims of local communities over coastal resources. Mangrove laws also provide for a protective greenbelt or buffer zone along coastlines and riverbanks (see below).

Therefore legislation that conserves, protects and rehabilitates mangroves in the Philippines and in the region has not been wanting — it is their implementation that is absent or generally weak, hampered by lack of manpower and resources, overlapping jurisdiction and corruption (Primavera, 2000a).

Inventory of mangrove areas and aquaculture ponds

Although conversion to salt beds, agriculture, settlements, and overexploitation by coastal dwellers have caused mangrove decline, aquaculture remains the major causative factor at least in Southeast Asia (Primavera, 1995, 1997). .Most of the thousands of hectares of brackishwater ponds in the Philippines (Fig. 2) and Indonesia were mangrove swamps developed for milkfish cultivation — such pond culture dates back to at least 1400 in Java, Indonesia (Herre and Mendoza, 1929). However, the high rates of 25-80% mangrove loss in the region (Table 2) over the last three decades (Low et al., 1994) have coincided with the Shrimp Fever of the 1980s (Primavera, 1997, 1998). In Vietnam, a total of 102,000 ha of mangroves were cleared for shrimp farming from 1983 to 1987 (Tuan, 1997). Shrimp farms in Thailand accounted for 32% or 65,150 ha of the total 203,600 ha of mangrove area destroyed between 1961 and 1993 (Menasveta, 1997).

There is a need to update these figures by means of an inventory of mangrove and culture pond areas in Southeast Asia. Mangroves may be classified according to geomorphological (estuary, delta or lagoon, Fig. 3) and ecological (fringing, overwash or island, riverine, dwarf, basin and hammock) types influenced by hydrology and topography (Lugo and Snedaker, 1974).

Fish/shrimp pond areas also need to be classified according to former land use (pristine or degraded mangrove, agricultural land), tidal level (intertidal or supratidal), status (operational, abandoned/unutilized or undeveloped), etc.

Zonation

Based on their ecological and economic functions, mangroves can be designated into four zones: a) preservation for coastal protection, biodiversity, and ecotourism; b) sustained yield of forestry and fisheries products; c) conversion to aquaculture, agriculture, salt beds and other uses; and d) rehabilitation or reforestation. Mangrove conversion to ponds and other uses may only be applied to countries whose swamps remain luxuriant. Some ecologists have recommended that such conversion should cover no more than 20% of a given mangrove area (Saenger et al., 1983) and target only degraded mangroves that are not ecologically critical. In the Philippines where only a few mangrove forests remain, the solution lies in replanting of degraded areas and reverting abandoned or underutilized ponds back to mangroves.

Areas to be preserved for coastal protection are called mangrove greenbelts or buffer zones (although they also include beach forests which comprise mangrove associates, outside of true mangrove species). Practically all countries in Southeast Asia require a coastal greenbelt with ranges of 20-100 m wide for the Philippines (Table 3), 100 m for Malaysia (recommended by the National Mangrove Committee), and 200-540 m (width = 130 x mean spring tide range) for Indonesia. Forming part of the preservation-conservation zone, such greenbelts and buffer zones should be retained or planted not only along shorelines and riverbanks but also between adjacent uses, e.g., shrimp pond and rice field.

Mangrove Rehabilitation

Many government and NGO initiatives involve the planting of mangroves in existing seagrass beds, and of mangrove monocultures of *bakhaw* or *Rhizophora apiculata, R. mucronata* and *R. stylosa* (although natural

monospecific stands of mangroves do occur such as of *R. apiculata* in more protected portions of bays). Therefore mangrove projects should follow biophysical criteria, e.g., suitable species and seasons to avoid high mortality rates. Suitable sites should match the species to corresponding tidal level (Fig. 4) and exclude seagrass beds and mudflats which are habitats in themselves. Locally adapted and existing mangrove species should be planted in a given area, such as *Avicennia marina* and *Sonneratia alba* in seaward zones, and *Rhizophora* species in more sheltered areas. Multispecies mangrove nurseries can be established for the production of planting materials from both seeds and germinated wildlings.

Mangrove-Friendly Aquaculture

For aquaculture to be sustainable, its impacts on mangroves must be reduced or mitigated. Already, the culture of seaweeds, mollusks and fish in cages in subtidal waterways is both compatible with mangroves and amenable to small-scale, family level operations (Primavera, 1993, 1995). But there remains a need for Mangrove-Friendly Aquaculture (MFA) technology in the intertidal forest that does not require clearing of the trees. MFA may be applied on two levels: a) silvofisheries or aquasilviculture where the low-density culture of crabs, shrimp and fish is integrated with mangroves, and b) mangrove filters where mangrove forests are used to absorb effluents from high-density culture ponds (Primavera 2000b).

A review of low-density MFA systems in Asia includes the traditional Hong Kong *gei wai* and Indonesian *tambak* that are decades- to centuries-old technologies, while silvofisheries in Indonesia, mixed shrimp-mangrove systems in Vietnam, and aquasilviculture ponds and mangrove pens in the Philippines and Malaysia are more recent state-initiated projects (Table 4). Unfortunately, ponds which are the predominant MFA system alter mangrove hydrology and ecosystem functions through the construction of gates, dikes and channels (Primavera, 2000b). By contrast, mangrove pens only require net enclosures with minimal impacts on mangrove hydrodynamics and vegetation — mud crab culture in pens is the most financially lucrative and environment-friendly among MFA systems. However, continued dependence of crab culture on fish biomass (popularly called 'trash' fish) and natural seedstock may impact negatively on food supplies of local people and wild crab fisheries, respectively (Williams and Primavera, 1998).

On the other hand, the filtration function of mangroves can be applied in more intensive aquaculture farms. In a study to assess such capacity, effluents from a shrimp Penaeus monodon pond were made to pass through a natural mangrove stand (predominantly *Avicennia rumphiana/A. officinalis/Nypa fruticans)* and water quality was monitored as seawater from a creek was conditioned in a reservoir, used in a shrimp pond and treated in the natural mangrove stand (Primavera et al., unpub. ms.). Twenty-four hour monitoring of solids and nutrient levels showed that retention of effluents in the mangroves for 6 h reduced suspended solid levels by 64.2%, sulfide by 34.0%, NH_3 by 24.8%, and NO_3 by 18.7%. First order estimates of 2.18-6.54 ha of mangroves needed to treat N wastes from one ha of shrimp pond (Table 5) were based on stocking density of 10-30 postlarvae/m^2, 20-30 g harvest size, 4% biomass feeding rate, mean daily removal rate of 0.158 mg NH_3-N/L and 0.483 mg NO_3-N/L, volume of water drained, and area of the mangrove stand. Greater mangrove biomass increase in the natural mangroves receiving effluents vs a control mangrove (with no effluents) provided evidence of nutrient assimilation.

Waste processing is only one of the many ecological services required by shrimp farms aside from food inputs, postlarval nurseries and water supply. The "ecological footprint" or ecosystem area that provides these goods and services to a semi-intensive shrimp farm in Colombia has been calculated as 35-190 times the actual surface area of the farm (Kautsky et al., 1994).

The "mangrove-friendliness" of brackishwater aquaculture systems can be evaluated in terms of how they affect the basic resource and regulatory functions of the mangrove ecosystem. One such evaluation is the Mangrove-Friendly Index for aquaculture systems by J. Higano (SEAFDEC/AQD, 2004) which factors in location of the aquaculture pond within the mangrove zone, production efficiency, nutrient balance inside the pond and outside in the receiving waters, culture intensity and socioeconomic impacts (Table 6).

OTHERS

Proper siting and management of farms, ICZM

Integrated coastal zone management coordinates the interests of various stakeholders, e.g., fisheries, aquaculture, forestry, settlements and navigation to ensure the optimal use of resources, maintenance of biodiversity, and conservation of critical habitats. The expansion of brackishwater pond culture in Southeast Asia has been a sectoral rather than holistic exploitation of the coastal zone. As intensive culture farms increase, the processing and disposal of effluents and sediments attain greater importance.

Therefore site selection of pond sites must consider the waste-absorbing or assimilating capacity of the environment, in addition to standard criteria of soil quality and tidal regime. Aside from proper pond siting and design, methods to mitigate the impacts on receiving waters include zero or reduced water exchange in combination with sedimentation and treatment ponds, pond liners, probiotics, sludge collection and storage, and the use of mangroves to process shrimp pond effluents (Primavera, 1998).

Natural resource use fees

The World Bank (1989) has recommended fees for the use of mangroves and other natural resources at levels commensurate to economic rent. Governments can also impose green taxes based on the Polluter Pays principle to mitigate the environmental and socioeconomic damages from brackishwater aquaculture (e.g., correcting water quality problems and rehabilitating mangroves and other degraded landscapes), revoke early policies and withdraw subsidies used to stimulate aquaculture expansion (e.g., declaration of coastal land as public resources, loans and tax breaks for aquaculture), and require environmental planning and performance as preconditions to the approval of pond culture loans, credits and access to resources.

ADDENDUM

The horrific 26 December 2005 tsunamis in the Indian Ocean have highlighted the importance of mangrove-beach forests in protecting coastal communities. We need a paradigm shift on how we view our shorelines, away from beach resorts with tropical palms swaying in the breeze to solid greenbelts of mangroves and associated species that provide critical buffer zones. We need another paradigm shift to redress environmental imbalance by reverting pond and resort areas and settlements along vulnerable coastlines back to lush mangrove-beach forests.

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Table 1. Philippine Brackishwater Aquaculture

Group		System	Method
Plants:	*Gracilaria*	stakes, rafts	extensive
	Eucheuma	longlines, beds (subtidal)	
Mollusc:	oyster, mussel	rafts, longlines, Stakes	extensive
		(subtidal)	
Marine/Brackishwater fish:	milkfish, grouper,	ponds, pens/cages	extensive, semi-
	snapper	(intertidal, subtidal)	intensive, intensive
Crustaceans:	prawns/shrimps	ponds	extensive, semi-
	Crabs	(intertidal)	intensive, intensive)

Table 2. Mangrove and shrimp culture pond area in Southeas Asia

Country	Shrimp ponds (ha)[a]	Mangroves	
	(ha)[b]	% Mangrove loss	(30 yr)[c,d]
Brunei Darus.	—	17,100	—
Cambodia	—	60,100	—
Indonesia	350,000	4,542,100	32 – 45
Malaysia	4,000	642,40	25 – 32
Myanmar	—	378,600	—
Philippines	60,000	160,700	40 – 80
Thailand	200,000	264,100	50 – 70
Vietnam	200,000	252,400	—
Total	814,000	6,317,500	
% world total	65	35	

[a] *Rosenberry 1999,* [b] *Spalding et al 1997,* [c] *Low et al (1994), d Sasekumar et al (1994)*

Table 1. Philippine Mangrove Greenbelt/Other Laws (*Primavera et al., 2004*)

P.D. 705 (1975)	Revised Forestry Code: mangrove strips in islands providing protection from high winds, typhoons shall not be alienated
P.D. 953 (1976)	Fishpond/mangrove lease holders required to retain or replant 20-m mangrove strip along rivers, creeks
BFD A.O. 2 (1979)	Min. 25% of total mangrove forest in given area completely protected as Mangrove Wilderness Areas
P.P. 2151 & 2152 (1981)	Declaration of 4,326 ha mangroves as wilderness areas, 74,767 ha as forest reserves
MNR A.O. 42 (1986)	Expansion of mangrove belt in storm surge, typhoon areas: 100 m along shorelines, 50 m along riverbanks
DENR A.O. 76 (1987)	Establishment of buffer zone: 50 m fronting seas/oceans and 20 m along riverbanks; lessees of FLA ponds required to plant 20-50 m-mangrove strip
DENR A.O. 77 (1988)	Integrated Social Forestry Program (provision of legal tenure incentives for co-management of forest resources)
DENR A.O. 123 (1990)	Award of 25-yr Community Forestry Management Agreement for small scale mangrove use, *Rhizophora* and *Nypa* plantations, aquasilviculture
DENR A.O. 15 (1990)	Policies on communal forests, plantations, tenure through Mangrove Stewardship Contracts; revert abandoned ponds to forest; ban cutting of trees in FLA areas; prohibit conversion of thickly vegetated areas
DENR A.O. 3 (1991)	Policies and guidelines for Mangrove Stewardship Agreement
DENR A.O. 23 (1993)	Combined 3-yr Mangrove Reforestation Contract and 25-yr Forest Land Management Agreement into 25-yr FLMA for families (1-10 ha) and communities (10-1,000 ha)

Table 4. Comparison of mangrove-friendly aquaculture systems in Southeast Asia (Primavera, 2000b)

	Hong Kong	Indonesia		Vietnam	Philippines	Malaysia
		Traditional ponds	Silvofisheries			
Technology and source, year started	traditional gei wai;mid-1940s	traditional *tambak*; circa 1400s	silvofisheries; State Forestry Corp; 1976(but trials in 1950s)	mixed shrimp-mangrove systems; State Forestry & Fishery Enterprises;	aquasilviculture; Fisheries Bureau and Environment Dept. (Forestry); 1987 mid-1980s	mud crab pens; Inland Fisheries Division; 1992
Objectives	shrimp, fish production mangrove, wildlife conservation	for food, fuel, fodder, fertilizer, soil stabilization	to solve forestry-fisheries conflict; mangrove rehabilitation, conservation	to relieve land use conflict; mangrove rehabilitation	mangrove management & conservation; fish production	increased incomes of artisanal fishermen
Area covered, present status	~250 ha, Ramsar Wetland Site	wide area	wide area (e.g., Cikiong: 6,600 ha, Balanak: 5,300 ha in West Java)	widespread	~ 10 experimental/ verification projects,	130 pens in Sematan, Sarawak
Pond/pen size	~10 ha ponds	1- 4 ha ponds	0.1 – 1 ha ponds	750 – 3,200 m^2 ponds	pens: 200 m^2 – 1 ha ponds: 0.13 – 2.6 ha	18 m x 9 m pens
Mangroves	natural *Avicennia Kandelia candel*	natural & planted *Avicennia*, *Rhizophora*	planted *Rhizophora*	planted *Rhizophora*	natural, planted	logged over, planted*Rhizophora*
Aquaculture	wild shrimp, fish, natural food	stocked milkfish, wild fish, shrimp; natural food	stocked milkfish, wild fish, shrimp; natural food, supplem. feeding	wild shrimp; natural food	stocked milkfish, mud crab; wild fish, shrimp; natural food, supplem. feeding	stocked mud crab raw (trash) fish feed
Problems	declining shrimp yields; industrial pollution; wildlife vs. aquaculture management	pond intensification	difficult management; conflict in choice of mangrove species	declining shrimp production; illegal mangrove conversion	mangrove tree mortality; raw (trash) fish substitutes	seed supply, feeds

Table 5. Mangrove: Shrimp Pond area ratios for nutrient removal in pond effluents

Reference	System	Mangrove: Pond Ratio (area)	
		N	P
Boonsong &	Intensive	8.96	7.82
Eiumnoh,1995			
Robertson &	Intensive	7.21	21.7
Phillips, 1995	Semi-int.	2.4	2.8
Kautsky et al.,	Semi-int.	6.4	6.4
1997			
This study	Intensive	2.91-6.54	
	Semi-int.	2.18	

Table 6. Index to express the impact against mangrove (Higano, 2003)

Mangrove friendly Index (MFI)

MFI = f (x1, x2, x3, ….) pond by pond, area by area?

x_1: location of culture area in mangrove zonation
x_2: coverage of shrimp culture in mangrove
x_2: production efficiency
x_3: effluent (nutrient balance outside the area)
x_4: sludge (nutrient balance inside the area)
x_5: water resources
x_6: intensity of shrimp culture
x_7: socio-economical impact

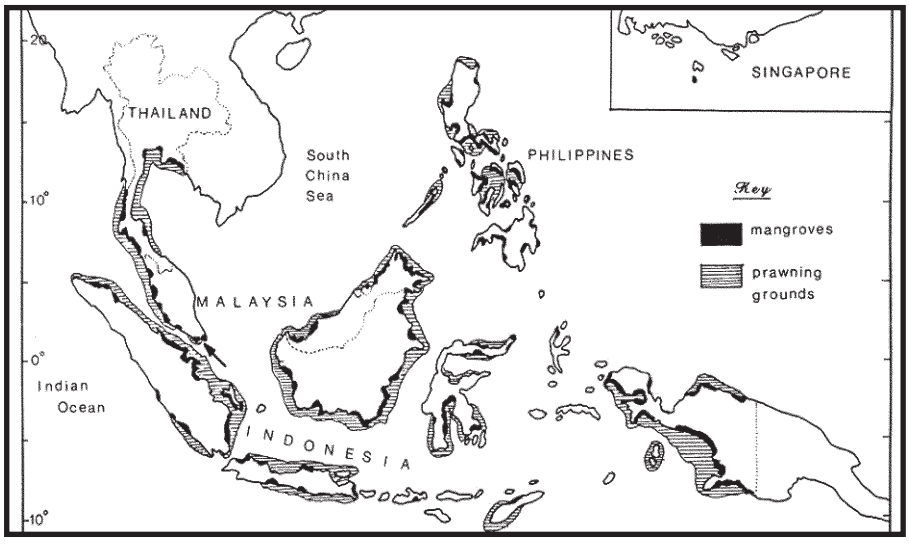


Fig. 1. Map of mangrove (and prawn) areas in Southeast Asia, excluding Vietnam.

Fig. 2. Change in area of mangroves and brackishwater culture ponds(ha) in geographical regions of the Philippines, 1951-1990 (from Primavera, 1997).

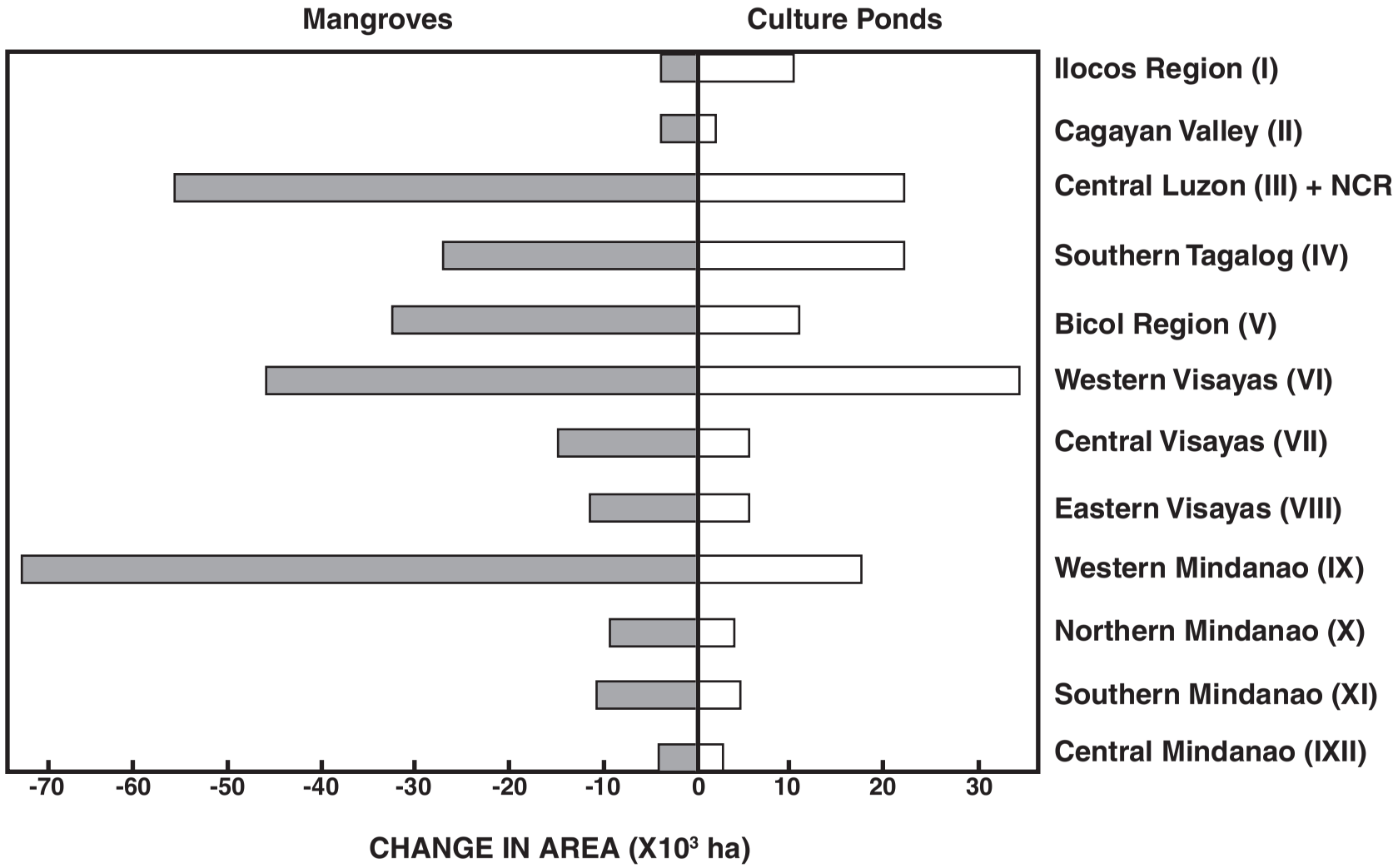
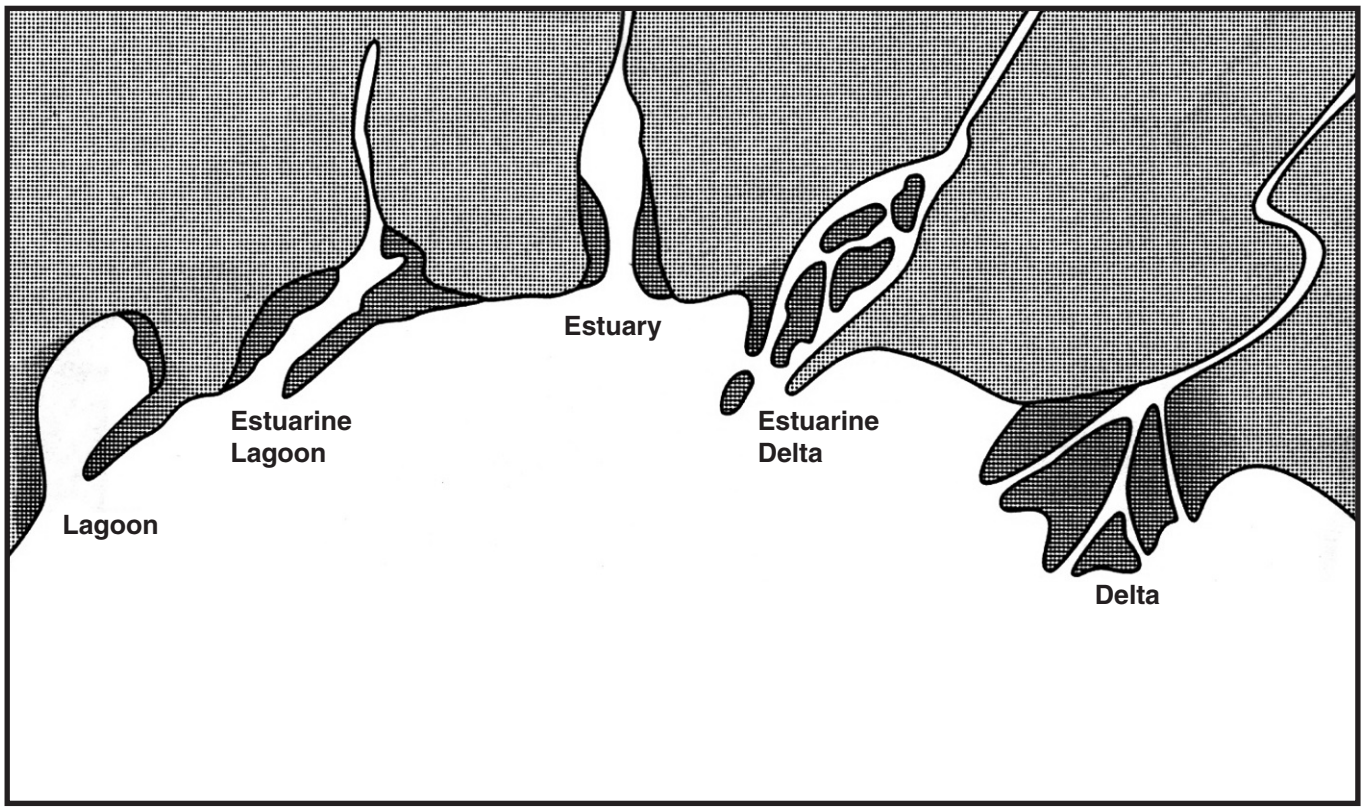
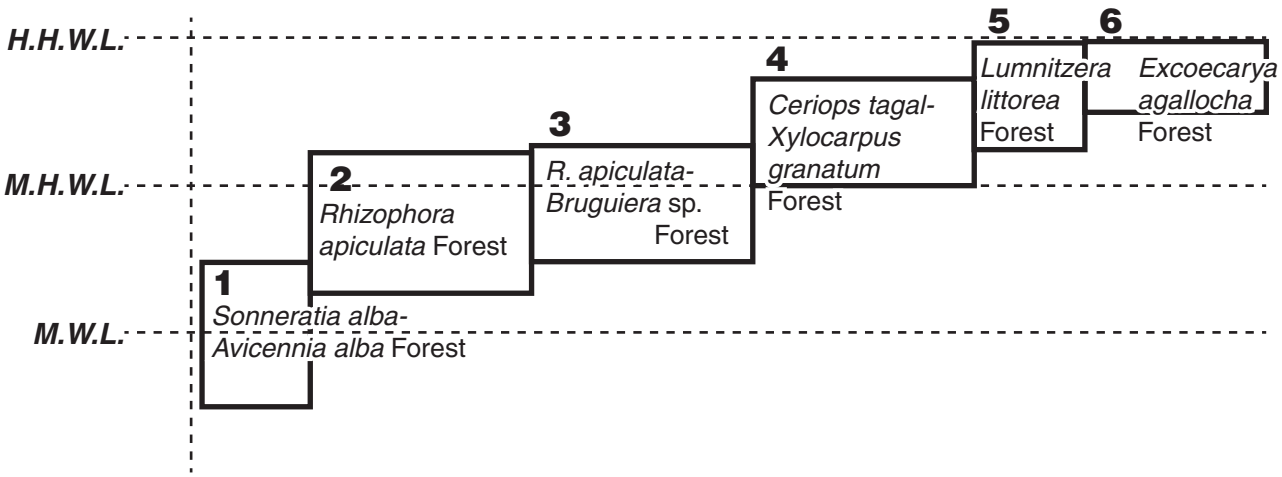


Fig. 3 Variety of mangrove settings based on geomorphology (from Kjerfve, 1990 in Field, 1995)



Variety of tropical settings in which mangroves are found
From Kjerfive, Davies 1973

Fig. 4 (from Furukawa and Baba, 2002).



MANGROVES MANAGEMENT AND DEVELOPMENT IN THE PHILIPPINES

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INTRODUCTION

Filipinos whose main daily diet consists of fish and rice, are highly dependent on the coastal resources. The development of coastal resources in the Philippines has been traditionally exploitative in nature. Government policies, which dictated development in both the uplands and coastal areas, have been based mainly on abundant available resources without due consideration for sustainability.

In the 1950s, vast tracts of mangroves were awarded to concessionaires and logged over for firewood and tanbarks. Mangrove woods were the preferred fuel source in coastal villages and most bakeries because of its high heating value, but a greater volume was exported to Japan as firewood but reportedly became the source of rayon.

In the 1960s, the government adopted a policy aimed at increasing fish production by converting large areas of mangroves into fishponds for the culture of milkfish (*Chanos chanos*) and shrimps. Such policy was promoted by a government program, which classified mangrove timberland for fishpond development and opened loan windows in most government banks to finance fishpond development.

It was only towards the end of the 1970s when the government realized the fishery value of mangroves. A National Mangrove Committee was formed in the then Ministry of Natural Resources, and a Mangrove Forest Research Center was created under the Forest Research Institute of the Philippines. The former was charged with the formulation of policies/recommendations for the conservation and sustainable management of the remaining mangrove forests in the country, while the latter worked for the generation of technology for the rehabilitation, production and sustainable management of mangroves. Not surprisingly, this "decade of awakening" was also significantly marked with an alarming decline in fish catch.

The government then opened loans to fisherfolk for the purchase of motorized boats and improved fishing gear. The program ended with most fishers unable to payback their loans as their fish harvests and income continued to decline.

The 1980s and 1990s were marked with significant efforts to rehabilitate destroyed mangroves and related coastal resources. In 1981, small islands indented by mangroves containing an aggregate area of 4,326 hectares were declared Wilderness Areas under Presidential Proclamation No. 2151. Also in the same year, Presidential Proclamation No. 2152 was issued declaring the entire island of Palawan and some parcels of mangroves in the country containing an aggregate area of 74,267 hectares as Mangrove Swamp Forest Reserves. In 1987, the Mangrove Forest Research Center was expanded to become nationwide in scope under the Freshwater and Coastal Ecosystems Section of the Ecosystems Research and Development Service of every regional office of the present Department of Environment and Natural Resources.

Not long after, the Coastal Environment Program (CEP) and the Coastal Resource Management Project (CRMP) were launched in the regional offices of DENR in 1993 and in 1996, respectively. These programs promote community-based approaches to coastal resource management, making direct stakeholders partners of government in the sustainable development and management of mangroves, seagrass beds, coral reefs, and other coastal resources.

MAJOR MANGROVE HABITAT USES AND CHANGES IN THE PHILIPPINES

The Philippines has about 7,100 islands surrounding the mainland of Luzon in the north, Visayas in the middle and Mindanao in the south. The country has about 18,000 km of shorelines and vast areas of mangroves totaling to 500,000 hectares in the early 1900s (Brown and Fisher, 1920). But over-exploitation, conversion of areas to various

uses, and the simultaneous logging of watersheds in the uplands, the country's remaining mangrove area was only 117,700 hectares in 1995 (DENR Statistics 1998).

With the destruction of mangrove areas, seagrass and coral reef ecosystems have also deteriorated. About 70% of the Philippines' coral cover has been destroyed, with 25% still in good condition and only 5% in excellent condition. As a result, the productivity of coastal fisheries measured in terms of fish catch also suffered a serious decline. It is estimated that there is a reduction of 670 kg in fish catch for every hectare of mangrove forest that is clear-cut (CRMP 1998).

ENVIRONMENTAL AND SOCIAL IMPACTS OF MANGROVE HABITAT CHANGES

A. Environmental Impacts

- Shoreline erosion especially in most of the typhoon prone areas

- Decline in forest structure and diversity of plant species in most of the remaining mangrove stand. Mangrove vegetation has been generally reduced to narrow strips and patches indenting the coastlines consisting of usually less than half a dozen species of trees and associated plants. Early works such as that of Brown and Fisher in 1920 reported 25 dicotyledonous tree species in Philippine mangrove swamps. Salvoza (1976) and Quimbo (1971) reported 22 and 29 species, respectively. Most of the remaining mangrove strips and patches are dominated by stunted *Sonneratia alba* and *Avicennia marina* which are adapted to sandy coralline shorelines and survive cuttings because of their inherent sprouting ability. Original mangroves species were said to be comparable to commercial forests of the land (Brown and Fisher 1920). Reportedly, mangrove forests included trees of 1.35 meters in diameter and stocks of 650 m^3/ha for old-growth and 146.69 m^3/ha for young-growth mangroves in Palawan (Francia 1971).

- Decline in fishery. The degraded forest structure of Philippine mangroves that consequently brought decline in its ecosystem functions (including fisheries) is aggravated by a parallel destruction of equally important coastal ecosystems.

- The decline of catch per unit of fishing effort since 1948 (Fig. 2) has run parallel with the decline of mangrove resources in the Philippines (Fig. 1). Such trend supports Odum's (1982) estimate that about 50-75% of the world's commercial species are dependent on mangrove swamps, marshes, seagrass meadows, mudflats and coral reefs for habitat and his further report on fish biomass in mangrove swamps to be 6.8 to 11.5 times that in adjacent open waters.

- Negative impacts of mangrove conversion to fishponds

  The decline of mangroves due to conversion to other uses brings about a consequent decline of the following ecological functions of mangroves:

  - Nursery grounds for fishes, shrimps, crabs and shellfishes
  - Production of leaf litter and detritus material which provides a valuable source of food for marine animals
  - Protection of shore and estuaries from storm waves and erosion
  - Pollution sink for nearshore water
  - Wildlife habitat, and
  - Biodiversity

  The conversion of mangrove swamps into fishponds simply means a substitution of a formerly highly diverse and naturally productive ecosystem into simplified and highly input-dependent ponds that

are economically and ecologically unstable. Fishponds are plagued with problems such as diseases, acid soil, deteriorating water quality, seepage of water through dikes, and market fluctuations resulting to low production. Many shrimp farms have been abandoned in the Philippines and elsewhere in Southeast Asia because of low productivity (White & Trinidad, 1998). A recent study showed that 20% of the fishponds in Negros Oriental and 40% in Bohol, both in the Philippines, are unproductive (Alcala 1982).

- Rising incidence of "fish kill" and "red tide" have been attributed to either total loss or insignificant functions of the remaining degraded and adversely altered mangrove habitats aggravated by high chemical and fertilizer inputs from agro-ecosystems and developed fishponds plus other types of pollutants from industries and domestic waste waters.

B. Social Impacts

Direct economic values estimated in the Philippines for mangrove wood and fish products combined range from USD1,396 per hectare per year (Padilla et al 1996; Schatz 1991 & Trinidad 1994). Figure 4 presents a summary of mangrove ecosystem value averages from around the world, which sum up to USD3,294 ha/year (Constanze et al. 1997). White and Trinidad (1998) estimated the mangrove ecosystem value at USD600/ha/yr, a conservative estimate that considers only food production and raw materials. But while variations in economic values attributed to mangrove ecosystems may be wide, there is no doubt that the conversion to fishponds and other uses result in significant monetary losses.

And who are most affected by such economic loss? Surely, the municipal fisherfolk are mostly affected because they do not have the capital to develop fishponds and fishing gears to engage in commercial fishing. Because of this, they are confined to nearshore fishery provided for under the Local Government Code of the Philippines.

The significant destruction of coastal habitats (mangroves, seagrass beds and coral reefs), overfishing (more than 70 fishers/km^2), illegal fishing practices (cyanide, blast fishing, trawl and fine mesh nets) and the encroachment of commercial fishers have caused a significant decline in fish catch and fish quality of municipal fisherfolk.

The municipal fishing sector comprises the majority (68%) of the one million people engaged in fishing industry (roughly 5% of the country's labor force) in the Philippines, but it contributes only about 30% of the total fish catch, while the 28% engaged in aquaculture and only 4% in commercial fishing contribute 60% of the national fish catch (BFAR 1997).

Fisheries associated with mangrove forests, collected by the poorest of the poor, constitute some 0.67 mt/ha/year to total fisheries (CRMP 1998). Alcala (1982) cited one case of mangroves being a substantial source of livelihood for our coastal population – in South and North Bais Bay where 20-30 families were wholly dependent on the edible mollusks, sea cucumbers and crustaceans harvested from surrounding mangrove areas. Some 979 kg/ha/year of 26 species of edible shells, 297.1 kg/ha/year of 16 species of sea cucumbers and an unknown yield of fishes and crustaceans were harvested by the families. This provided an estimated income of at least Php76.36 ha/year from shells and Php92.20/ha/year from sea cucumber.

MANGROVE MANAGEMENT AND DEVELOPMENT EFFORTS

■ Self-help Community-based Mangrove Plantation of Banacon Island, Getafe, Bohol

Banacon is one of several islands of Getafe, Bohol surrounded by bakauan (*Rhizophora* spp) plantations established through community-based management since 1957. The existing plantation (more than 400 hectares) attracts many local and foreign visitors, who come to appreciate the monumental success that the islanders have achieved in mangrove rehabilitation. With the plantations, the islanders have been earning the following:

- Propagules. Harvesting and selling of propagules provide additional income to the community. Conservative estimates put production from a 5-20 year old bakauan-bato (*R. stylosa*) plantation at about 100,000 to 320,000 propagules /ha/year.

- Firewood/charcoal, piles and posts. Allowing 20% mortality, a hectare of bakauan-bato plantation spaced at 0.5m x 0.5m will yield 32,000 trees. Through progressive partial thinning operations of up to 50% carried on from the 5th up to the 10th year, a hectare plantation yields 16,000 poles. This gives a gross return of Php80,000 at a price of Php5.00/pole measuring 3-6 cm in diameter and 4-5m long.

  At the end of the 20th year, the crops will be good for woodpiles and posts. A hectare of this plantation can yield 14-16 cm diameter and 10 m long poles.

■ Other livelihood

- Amatong. Amatong is a cheap, environment-friendly, indigenous, yet lucrative fish-aggregating device that originated in Banacon Island, Getafe, Bohol. Amatong is also known as "miracle hole" because it can provide shelter and food to various kinds of fish, crustaceans and other organisms making amatong fishing an economically viable livelihood. The site suitable for this method for fishing should be protected from any form of disturbance, shallow (no more than knee-deep) and cleared inter-tidal areas with sandy rocky substrate within a mangrove forest and near seagrass beds and coral reefs as shown below.

  The amatong can range from 2 to 4 m in diameter or 2m x 4m in area and 0.5-1.5 m deep. It may be circular, rectangular, or funnel-shaped. The distance between two amatong should be at least 50 m. Harvesting is done for every 3-5 months by installing a net around the boulders and then removing the boulders one after another and piling them outside the Amatong. About 10-20 kg of the following fishes are harvested from each amatong:

  - Kitong (*Siganus* sp)
  - Danggit (*Siganus* spp.)
  - Lapu-lapu (*Epeniphelus* sp.)
  - Mangagat (*Lutjanus* sp.)
  - Bunog (*Glossogobius* sp.)
  - Alimasag (*Portunus* sp.)

- Seaweeds. *Eucheuma spinosum* farming is a viable livelihood for beneficiaries of the Coastal Environment Program in Mahanay and Banacon Islands, Getafe, Bohol. Using mono-lines, these Eucheuma farms are extensively spread along tidal flats areas and reach the edge of mangrove plantations.

Contract reforestation project

A contract reforestation project was implemented in several Philippine mangrove areas. Contracts were awarded in four ways – to families, to communities, to local government units, and to non-government organizations. This project was successful in some regions, particularly the Central Visayas Region where about 1,700 hectares of mangroves were turned over to the government. Additionally, these plantations impacted fisheries production in terms of gradual increase in fish catch to abut 5-10% above baseline. However, in many areas in the Visayas and Mindanao, survival was low, with some plunging to 0% compared to the national average of about 54%. Monitoring and evaluation reports pointed to the following problems and issues contributing to the very low survival:

- Poor site selection
- Lack of acceptance by the community or local leaders
- Barnacles and other infestations
- Lack of preparation in project implementation

- Poor understanding and appreciation of the importance of mangroves
- Conflicting interests of various users/stakeholders
- General lack of information and actual experience in mangrove rehabilitation and management
- Contract reforestation benefited only few contractors

Mangrove tenurial instruments

- Nipa-Bakauan Special Use Permit. The Nipa-Bakauan Permit was issued to individuals or groups who are interested in managing and maintaining Nipa (*Nypa fruticans*) and bakauan (*Rhizopora* spp.) stands, after satisfying the documentary requirements and payment of corresponding fees. Because of the government's present total ban on the cutting of mangroves (Republic Act No. 7161), this has been reduced to Nipa Special Use Permit.

- Community-based Forest Management Program (CBFMP). The CBFMP is the most recent community-based program of the Government of the Philippines. The Program covers mangroves as well as upland forest areas. It is a national strategy designed to ensure sustainable forestry and social justice. The DENR and concerned local government units work together with the communities in public forests or areas of interests. The main intention is to protect, rehabilitate, manage, conserve and maintain the mangrove resources. For this, it has adopted the theme "people first and sustainable mangrove forest management will follow," meaning that the needs of the people (improved well-being, strengthened capability for sustainable forest management) should be met first before addressing the country's forest management problems.

  The program also aims to develop and strengthen partnership among community, local government, DENR and other groups or organizations. It is applicable in all areas classified as forestlands and allowable zones in protected areas without prior vested rights.

  The government, through the DENR, issues a tenurial instrument called "Community-Based Forest Management Agreement (CBFMA) to the organized participating community. The CBFMA is a production-sharing agreement between organized communities and the government to develop, conserve, utilize and manage a specific portion of the forestland, consistent with the principles of sustainable development and pursuant to a Community Resource Management Framework Plan (CRMFP). The CRMF defines the terms and conditions for access, use and protection of the resources within the CBFMA areas.

  The CBFMA as a land tenure is good for 25 years renewable for another 25 years. To date, only a few CBFMAs on mangroves have been issued. Under the DENR's Coastal Resources Management Project (CRMP) assisted by the United States Agency for International Development (USAID) and managed by the Tetra EM Inc., seven CBFMAs have been issued and another is being processed. These area agreements, which CRMP regards as "Best CRM Practices," cover 3,352 ha, 414 members and about 23 km of shoreline.

Integration of aquaculture in mangrove management

- Aqua-silvi-pasture experience: A Case of Failure

  Aqua-silvi-pasture is a management strategy that combines and harmonizes fish production and mangrove development. It is a favorable livelihood opportunity to sustainably augment the fisherman's income and at the same time reforest the coastal ecosystem.

The project site. The site is situated in the mangrove timberland area in Barangay Hunan, Buenavista, Bohol located between 10°05"and 10 degrees 06 North latitude and 124°07" and 124°08" East longitude. It is about 200 meters north of Barangay Hunan. South of the pond site is an illegally developed fishpond associated with a patch of natural mangrove stand. To the west is Cebu Strait and a narrow strip of mangrove forest. To the north is a nipa stand

and to the east is a portion of another illegally developed fishpond bordered easterly by an elevated ground planted with coconut.

For reasons of accessibility, legality and ease of developing, an abandoned 4.0 ha fishpond was chosen for the project by the DENR. After the site was identified, actual food survey was made to determine the extent of the pond area. Coordination with the local government units was then carried out and a public consultation was scheduled and conducted. The mangrove beneficiaries were organized and briefed on the objectives, scope and limitations of the project. An organization was formed where members elected their officers. The fishpond was under litigation in the Municipal Trial Court, which decided in favor of the government/DENR.

Aquasilviculture pond preparation. The old and damaged dikes were repaired and reinforced with coral boulders. A single sluice gate was constructed on the southern section of the western dike. Close to the gate, was a bunkhouse. Immediately after the entrance to the project is the goat pen. The old nursery pond on the northeastern corner of the pond was repaired. In the middle of the production pond was the silviculture component where the mangrove plantation of Bakauan-bato (*Rhizophora apiculata*) was established spaced at 1.0 m x 1.0 m. The plantation has a total of 2.4 ha comprising 60% of the total area of the fishpond.

Forming the pasture component were 1 mature male and 5 female goats. These goats were herded daily in the nearby grassland area and at night brought back to the pen. At times, these goats were allowed to roam along the dikes planted with grasses (mostly *Chloris* spp) and Dampalit (*Sesuvium portulacastrum*). Leaves of Pagatpat (*Sonneratia alba*) and Bugalon (*Avicennia marina*) were also harvest and fed to the goats.

For the aquaculture component, nursery and production ponds were provided. The shrimp fry were stocked first in the nursery pond until they reached fingerling stage. They were then transferred to the production pond for rearing to harvestable size. While in the nursery pond, the fry were fed raw eggs. The production pond was first drained and then fertilized with complete fertilizers and chicken dung to promote the growth of green algae. In rearing the shrimps, cooked cassava tubers were used as feeds. The aquaculture component has an area of 1.60 ha, 40% of the total pond area.

The experience. Prior to the implementation of the project, a very well attended consultation with the local government and the community was carried out to determine public sentiment for the project. Most of the local officials were present, although not all were for the project. With majority of them for the project, Hunan was chosen as the project site.

A number of villagers who attended the forum formed as the nucleus of the organization that would manage the project for five years from 1990 to 1994. A total of 52 members then elected their officers of the organization aptly called (*Nagkahiusang Lumulupyo sa Katunggan sa Barangay Hunan*" (United Mangrove Settlers in Barangay Hunan). At fist, many of the members were active in rendering labor services but after sometime the number of workers became fewer until only one family was left to attend to the project. On the third year when the collapse of the organization became evident, a meeting was called and a community organizer was invited to help revitalize the project and its participants.

During the meeting, expectations and apprehensions were solicited, and hope for a successful project implementation was shared with everybody. There was a rekindling of the involvement of the members but it was very brief. Not much later, only the family of the president really stuck it out with the project.

Initial pond stocking started in June 1991 with some 5,000 milkfish fry purchased at P350.00/thousand. The first harvest yielded only 100 kg, a total disappointment not only because it fell short of expectations but also because the fish were very small (about four inches). The mortality of the stock was 41%. After the first harvest the pond was again prepared for the next stocking. Shrimp fry were procured and directly seeded in the production pond. Eight months later in June 1992, the stock was harvested. The stock grew to a very expensive size but the mortality was very high at 92%. Only 480 pieces of shrimps were harvested. Four months after the second harvest the pond was stocked again with 5,000 milkfish fry, which were harvested nine months after. The survival was only 2.1% but the milkfish grew to a very expensive size. Stocking was then discontinued because of successive failures.

Pasture Component. This project started with one buck and five does. The goats were herded daily in the vicinity of the project and at times were allowed to graze along the dikes where Dampalit was planted. After a time

the Dampalit was completely grazed and herding was made outside the dikes. By the fourth quarter of 1991 all four does gave birth to six young goats but only four survived. In the early part of 1992, a total of nine goats were being herded. One was sold for P500.00 and the money went to the family of the project caretaker. Before December 1993, 25 months after the project implementation, the number of goats reached a total of 16 heads. During this time, the caretaker decided to sell the mature bucks, but retained the does. But on December 26, 1993, typhoon Ruping badly hit the Visayas and left the goats dead for drowning with only a pair survived.

Silviculture component. Bakauan-lalaki (*R. apiculata*) was planted in the designated silviculture component area in the pond equivalent to 60% of the total area. The area was partly enclosed by the production ponds in the north, south and western sides. The seeds were planted at a space of 1.0 m x 1.0 m. The plants had a mean survival of 83.33% and the plants showed excellent growth. By December 1995 the plants had attained a mean diameter of 37.33 mm, and mean height of 145.51 cm, and developed a mean of 240.03 leaves and mean of 15.35 roots.

Learnings. The project site was under litigation and all legal problems were solved before the project started. But like any misinformed constituent, the village folks of Hunan remained apprehensive and reluctant to cooperate with the project for fear of retaliation from the losing claimant. No amount of social and community organizing could persuade them to join the project. Instead, the family participants started losing contract with the project leader until only one family remained.

The ponds were not stocked right away because of the non-availability of fry in the market due to the El Niño and the typhoon that hit the country. The forage demand of the increasing number of goats could not be met by merely planting of blocks of grasss and Dampalit (*Sesuvium portulacastrum*) along the dikes. The pond supply of forage was insufficient for the goats so that it was necessary to herd the goats outside the ponds in the nearby foraging area. The pond is located a few meters from the foot of the hillock and the dikes enclosing the pond were so located that the rainwater from the hillside flowed into the ponds. This then diluted the pond waters and melted the green algae. The dikes although rock-reinforced were frequently washed out by flood and strong waves. Closer inspection of the dikes revealed that the soil was sandy clay and therefore prone to collapsing.

The participation of the community waned so that at the end of the project only one family was left. During the construction of the dikes and pond excavation, several families participated in the activities because there was a minimal remuneration for the services rendered. But in the last three years, when their services became voluntary, members shied away from the project and their involvement became minimal.

Aquasilviculture for marginal farmers: A Case of Success

Aquasilviculture is a management strategy that combines and harmonizes fish production and mangrove development. The strategy has become favorable livelihood opportunity to sustainably augment the fishers income and, at the same time, reforest the mangrove. This was implemented in Catanauan, Quezon and Camarines Norte of Southern Luzon on areas of 0.8 ha and 0.25 ha, respectively. Unlike the aquasilvipasture in Hunan, Bohol, this mangrove friendly aquaculture attained a certain degree of success. The success can be attributed to the following:

- Careful selection of site
- Appropriate selection of aquaculture species
- Careful handling of seeds and fingerlings
- Appropriate selection of mangrove mother trees
- Proper timing and establishment of aquaculture ponds
- Careful pond preparation and adequate stocking, and regular maintenance and monitoring

An analysis of the economic benefits of this project is shown below:

Economic criterion	PhP at 15% Interest Rate	PhP at 20% Interest Rate
Net present value	207,336	108,850
Benefit-Cost Ratio	2.27	1.97

SUMMARY, CONCLUSION AND RECOMMENDATION

Conversion of mangroves to fishponds has been the major cause of the decrease and degradation of Philippine mangroves and accounted for about 175,000 ha (35%) of mangrove forests loss.

The government's objectives to increase fish production out of mangrove conversion to fishponds were not realized. Instead, it created adverse impacts, such as the loss of significant habitats and biodiversity, loss of fishery value resulting from the decline of the protective and ecological functions of mangroves as an ecosystem, and problems of unequal resource access.

To remedy these adverse impacts, government's efforts to bring back the lost resources through mangrove reforestation, proclamation of an aggregate of 83,593 ha of mangrove wilderness and mangrove swamp forest as reserve areas, and the launching of community-based programs focusing on the coastal environment and coastal resources management have since been vigorously pursued.

Nevertheless, fish catch and fishery resources have continued to decline. There are other important coastal ecosystem such as seagrass beds, algal beds and coral reefs that are less visible than mangroves but are equally important to maintaining the productivity of fisheries. Based on the above scenario, the following are recommended:

- Vigorously pursue efforts to bring back the lost productivity of denuded mangroves through sustained mangrove reforestation activities and protection of he remaining mangrove forests;
- Generation of technology to address gaps in mangrove friendly aquaculture;
- Rehabilitation and protection of other equally important coastal ecosystems;
- Strong political will among local leaders to implement fishery laws and institutionalize coastal resources management within their area of jurisdiction;
- Implementation of the Joint Memorandum Circular between the Department of Agriculture-Bureau of Fisheries and Aquatic Resources and the Department of Environment and Natural Resources on the reversion of abandoned and undeveloped fishponds back to mangrove forests;
- Harnessing coastal communities as partners in coastal resources management to include the mangroves, seagrass, algal, soft bottom and coral ref ecosystems.

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SUSTAINABLE PRODUCTION SYSTEMS OF AQUATIC ANIMALS IN BRACKISH MANGROVE AREAS: 2001-2005

(As of August 2004)

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INTRODUCTION

Under the Memorandum of Understanding (MOU) between SEAFDEC (Southeast Asian Fisheries Development Center) and JIRCAS (Japan International Research Center for Agriculture Sciences) an agreement was forged to collaborate on a research study on the growth, prevention and control of diseases of aquaculture fishes. Several studies are now being conducted at SEAFDEC AQD in Iloilo, Philippines. Under the same project, JIRCAS also implemented a research study on sustainable aquaculture in Thailand, "Sustainable Production System of Aquatic Animals in Brackish Mangrove Areas."

Implemented from September 2003 to February 2004, the study aimed to determine the role of benthic organisms as food of marine resources, the shrimp farming areas and the number of shrimp farms. Using six shrimp ponds with an area of 40 m x 20 m where the potentials of closed and circulating systems to purify shrimp farm wastewater were compared.

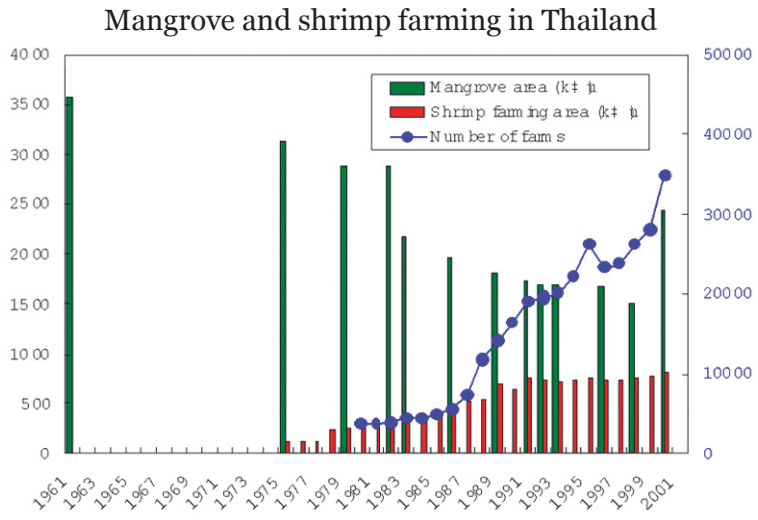
The shrimp culture in Thailand started in the mid 1970s and subsequently increased in mid 1980s with the intensification of production systems. The high inputs of intensification inversely resulted to the decrease of mangrove areas. In Samut Songharm Province which is situated in the Gulf of Thailand, mangrove areas decreased to almost 0 for the last 15-20 years (Fig. 1). Due to the concerted efforts of the residents in the community and in support of the Royal Princes of Thailand, mangrove tree planting was started in the coastal areas in 1999. Fig 1 shows the areas covered by mangroves in the Province of Samut Songharm that mark the decrease and increase of mangrove areas.

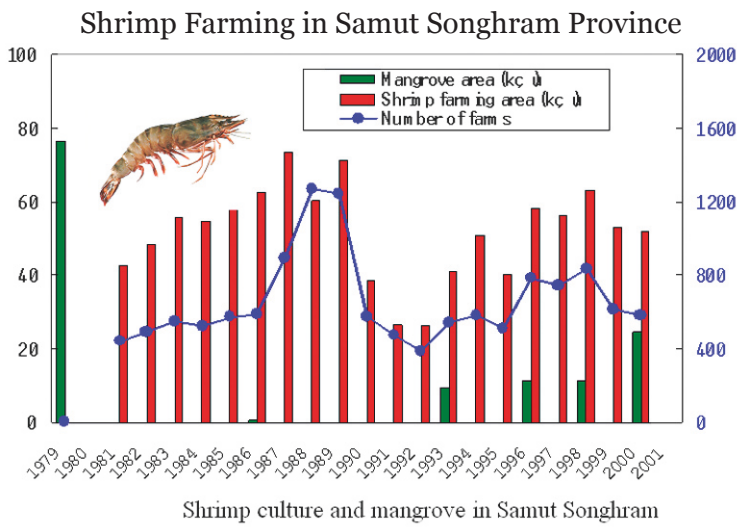
RESULTS AND DISCUSSION

Closed versus circulating system

Mangroves play a very important role in the ecosystem. The activities in the mangrove ecosystems include: production, circulation and purification. The experiment conducted in Samut Songharm area near Kasetsart University in Bangkok, Thailand made use of 6 ponds. Each pond has 40 m x 20 m area. Ponds 4 and 5 were planted to mangrove trees (*Rhizophora* spp). Pond 1 which used closed system served as the control. Under the circulated systems, two treatments were compared (Fig. 2). One treatment used 1:2 mangrove-shrimp ratio where one pond was planted to mangroves and the other two were stocked with shrimps. The water in ponds 2 & 3 comes from the pond where mangroves were planted and the same time serves as the receiving pond of the wastewater coming from the grow-out ponds 2 & 3. The other circulating system used 1:1 mangrove-shrimp ratio had one pond planted to mangroves and the other one stocked with shrimps applying the same circulating principle. Each shrimp pond was stocked with 12,500 pcs of shrimps at 20/m^2. After four and a half months of culture, the result showed that Pond 6 using circulating system with a ratio of 1:1 mangrove-shrimp pond yielded the biggest average size shrimp with FCR of 1.51. In Pond 2 to 6, the production, survival rate as well as average size indicates that purification of wastewater is effectively done in the circulating system between ponds 5 and 6. In Ponds 2 and 3, the ability to purify wastewater is not as efficient as in pond 6.

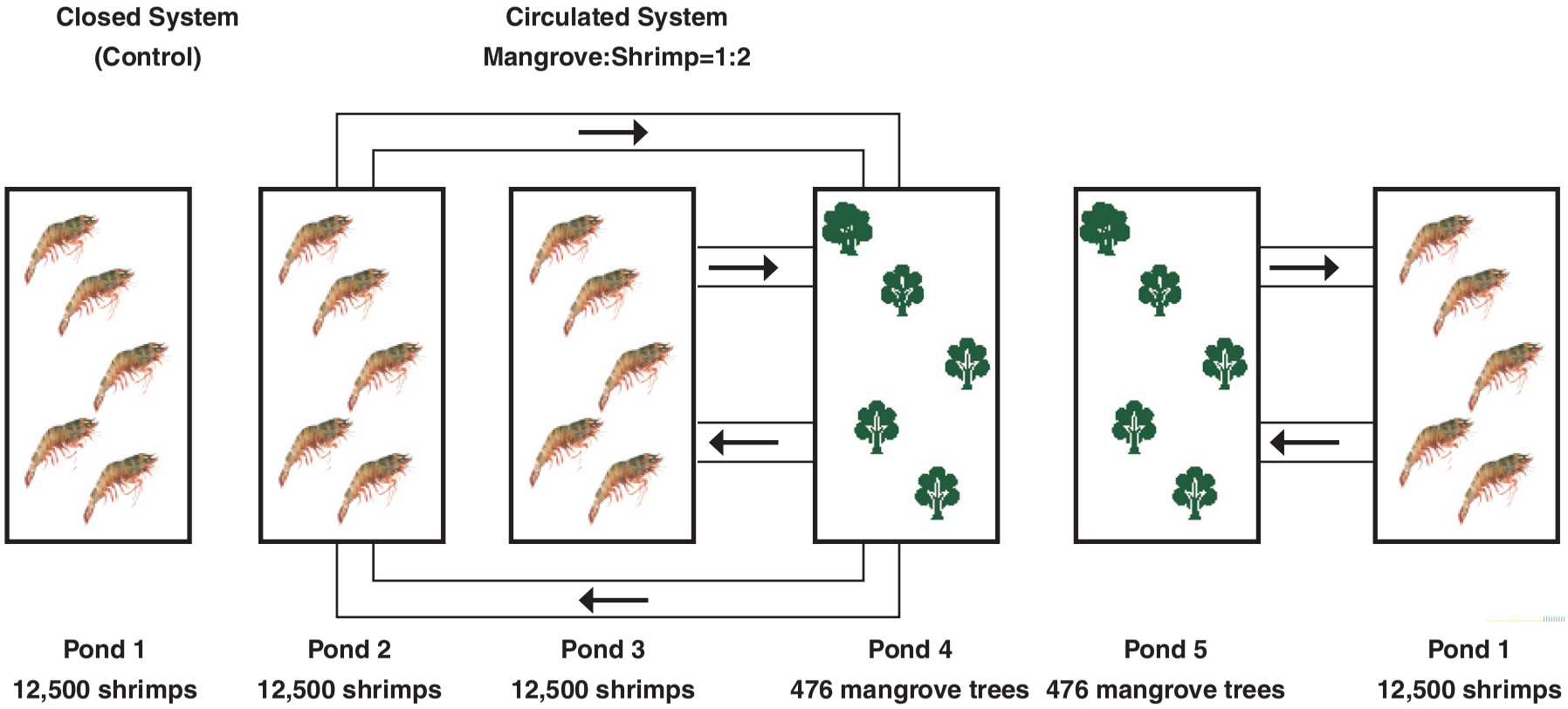
Figure 1. Shrimp culture and Mangrove in Thailand





Shrimp culture and mangrove in Samut Songhram

Shrimp culture and mangrove in Samut Songhram



Circulated System
Mangrove:Shrimp=1:1

Figure 2. Culture experiment for *Penaeus monodon*

Nutrient condition in culture ponds

This study also determined many kinds of nutrients condition, TDP and TDN in the shrimp ponds, however, results indicated that there is difficulty to distinguish their differences. Among the macro-benthos, the dominant species are the *Balanus* sp. Fig. 3 shows the macro-benthos found in the ponds. The trend of changes in wet weight were noted and shown in Fig. 4.

Figure 3. Results of experiment

Site : Samut Songhram coastal aquatic Research Station, Kasetsart University

Date: September 19, 2003 – February 12, 2004

	Pond 1 Closed	Pond 2 2 ponds	Pond 3 2 ponds	Pond 6 1 pond
No. of stocked (A)	12500	12500	12500	12500
Culture density (N/m^2)	20	20	20	20
No. of harvested (B)	8276	7735	7654	8433
Survival rate (B/A) (%)	66.2	61.9	61.2	67.5
Total Production (Kg)(C)	240.4	194.6	193.7	264.8
Production (Kg/ m^2)	0.30	0.24	0.24	0.33
Average size (C/B)(g)	29.0	25.2	25.3	31.4
Feed (Kg) (D)	352.8	345.4	320.6	400.1
FCR (D/C)	1.47	1.77	1.66	1.51

Figure 4. Macro-benthos

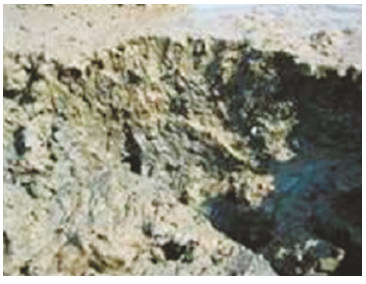
	Pond 1 Closed	Pond 2 Circulated	Pond 3 Circulated	Pond 4 Mangrove	Pond 5 Mangrove	Pond 6 Circulated
Nematoda(線虫)	○		○	○	○	○
Annelida(環形動物)						
Polydora sp.	○	○	○	○	○	○
Perinereis sp.		○		○	○	
Mediomastus sp.			○			
Capitellidae		○		○	○	
Polychaeta	○	○	○	○	○	○
Mollusca(軟体)						
Cerithium coralium					○	○
Thiara riquetii	○		○	○	○	○
Thiara scabra	○	○			○	
Thiara sp.	○	○	○	○		○
Melanoides tuberculata		○			○	
Cerithidea cingulata	○	○	○	○	○	○
Rissoidae			○	○	○	○
Iravadiidae				○	○	○
Assiminea brevicula				○		
Assimineidae	○			○	○	○
Stenothyra acuta	○					
Stenothyra sp.				○	○	○
Stenothyridae				○	○	
Eulimidae						○
Opithobranchia						○
Gastropoda					○	
Arthropoda(節足動物)						
Ostracoda	○		○	○	○	○
Copepoda					○	
Harpacticoida				○		
Balanus sp.	○	○	○			○
Isopoda					○	
Chironomidae			○	○	○	
Insecta				○	○	
Gammaridea				○	○	
Number of taxa	11	9	11	19	22	15

Balanus sp.

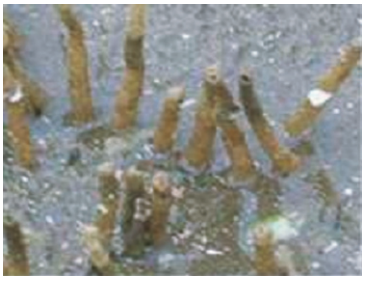
Cerithidea cingulata

Perineeis sp.

Polydra sp.



Perinereis



Polydra

Collection and culture polychaetes

Polychaetes collected from mud flat were cultured in tanks and found to be: a) possible to culture in short periods; (b) possible to reproduce; (c) increase the number; and (d) reproduce for the next generation (Fig. 5)

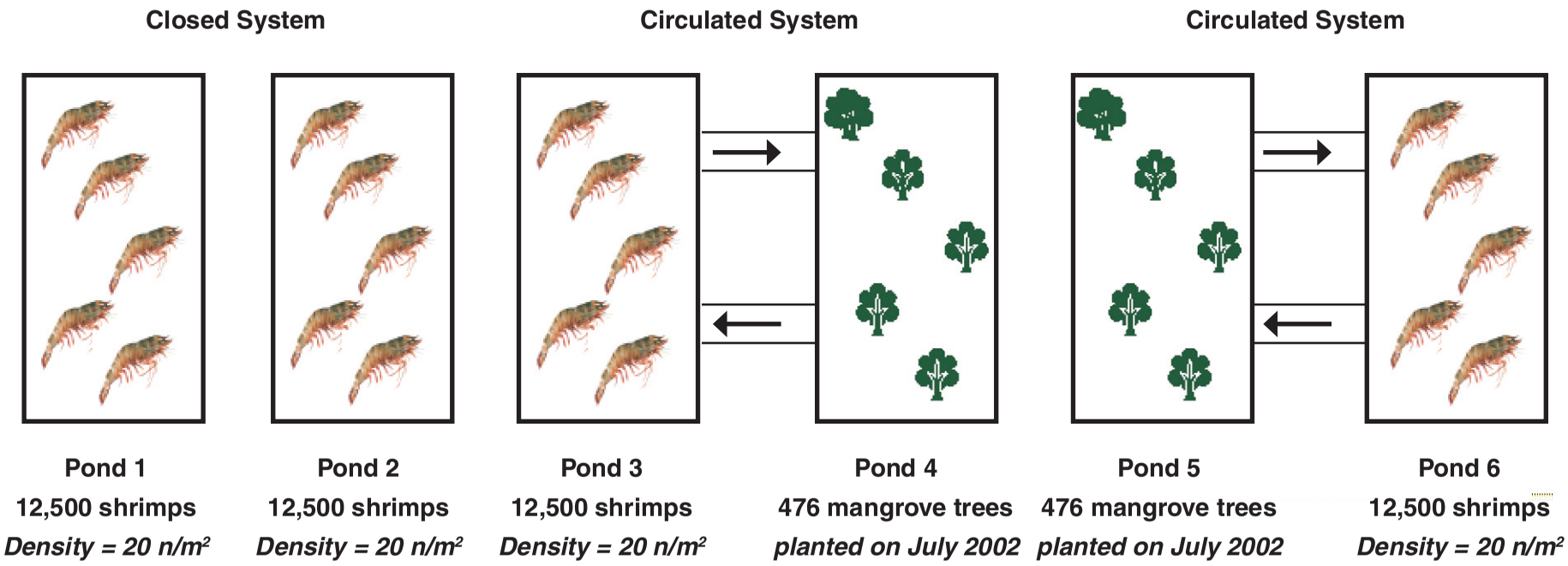
Another set of experiment was conducted to compare again the closed and circulating systems using another treatment. Closed system will be used for ponds 1 & 2 while circulating system for ponds 3 and 6 using the same mangrove-shrimp ratio (1:1) plus *Polychaetes perenereis* spp. Each shrimp pond was stocked 12,000 shrimps at a stocking density of 20/m^2. Water was exchanged every week in ponds 3 and 4, 5 & 6. The shrimps will be culture for four months.

Recommendations:

From the results of the series of experiments, the following technologies can be used to improve water and sediment quality:

1. water purification by mangrove (closed)
2. water purification of mangrove (circulated)
3. land preparation for shrimp culture
4. bio-mediation
5. sediment improvement using pump
6. paddle wheel

Figure 5. Culture experiment of *Penaeus monodon* (the second of May 24, 2004)



Experiment will be started on 24 May 2004, and continued about 4 months.
PL24 Penaeus monodon will be stocked in shrimp aquaculture ponds.
Rhizophora sp. were planted in mangrove ponds on July 2002.
Polychaetes perenereis spp were cultured in Ponds 3-6
Water was exchanged every week between Pond 3 and Pond 4, Pond 5 and Pond 6.

TECHNOLOGIES FOR IMPROVEMENT OF WATER AND SEDIMENT QUALITY

Water purification by mangrove (Closed)



Water purification by mangrove (Circulated)


Bio-mediation



Land preparation for shrimp culture


Paddle wheel



Sediment improvement using pomp

CODES OF CONDUCT FOR AQUACULTURE IN MANGROVES

The following Codes and Guidelines were presented during the Consultation to be used as references for the development of the Regional Code of Practice for the Responsible Aquaculture in Mangrove Ecosystems.

1995: FAO Code of Conduct for Responsible Fisheries

1999: Codes of Practice for Responsible Shrimp Farming (Global Aquaculture Alliance)

1999: Marine Shrimp Culture Industry of Thailand: Operating Guidelines for Shrimp Farms

2000: The Bangkok Declaration and Strategy

2001: Environmental Code of Practice for Australian Farmers

2001: SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia - Responsible Aquaculture

2002: Code of Practice for Sustainable Shrimp Farming (Philippines)

2004: Code of Conduct for the Management and Sustainable Use of Mangrove Ecosystems (World Bank, ISME, etc.)

1995: FAO Code of Conduct for Responsible Fisheries

Articles 9.1.3 States should produce and regularly update aquaculture development strategies and plans...to ensure that [it] is ecologically sustainable and to allow the rational use of resources shared by aquaculture and other activities.

Article 9.1.4 States should ensure that livelihoods of local communities, and their access to fishing grounds, are not negatively affected by aquaculture developments.

1999: Codes of Practice for Responsible Shrimp Farming (*Global Aquaculture Alliance, St. Louis, Missouri, USA, 1999*)

Guiding Principles for Responsible Aquaculture

Companies and individuals engaged in shrimp farming, singularly and collectively:

1. Shall coordinate and collaborate with national, regional, and local governments in the development and implementation of policies, regulations, and procedures necessary and practicable to achieve environmental, economic, and social sustainability of aquaculture operations;

2. Shall utilize only those sites for aquaculture facilities whose characteristics are compatible with long term sustainable operation while acceptable ecological effects, particularly avoiding unnecessary destruction of mangroves and other environmentally significant flora and fauna;

3. Shall design and operate aquaculture facilities in a manner that conserve water resources, including underground sources of freshwater;

4. Shall design and operate aquaculture facilities in a manner that minimizes effects of effluent on surface and ground water quality and sustains ecological diversity;

5. Shall strive for continuing improvements in feed use and shall use therapeutic agents judiciously in accordance with appropriate regulations and only when needed based on common sense and best scientific judgment;

6. Shall take all reasonable measures necessary to avoid disease outbreak among culture species, between local farm sites, and across geographic areas;

7. Shall take reasonable steps to ascertain that permissible introductions of exotic species are done in a responsible and acceptable manner and in accordance with appropriate regulations;

8. Shall cooperate with others in the industry in research and technological and educational activities intended to improve the environmental compatibility of aquaculture;

9. Shall strive to benefit local economies and community life through diversification of the local economy, promotion of employment, contributions to the tax base and infrastructure, and respect for artisanal fisheries, forestry, and agriculture.

1999: Marine Shrimp Culture Industry of Thailand: Operating Guidelines for Shrimp Farms (*Siri Tookwinas, et. al., 1999*)

2000: The Bangkok Declaration and Strategy

The Declaration

18.18 the aquaculture sector should continue to be developed towards its full potential, making a net contribution to global food availability, household food security, economic growth, trade and improved standards;

18.19 the practice of aquaculture should be pursued as an integral component of development, contributing towards sustainable livelihoods for poor sectors of the community, promoting human development and enhancing social well-being;

18.20 aquaculture policies and regulations should promote practical and economically viable farming and management practices that are environmentally responsible and socially acceptable;

18.21 national aquaculture development processes should be transparent and should take place within the framework of relevant national policies, regional and international agreements, treaties and conventions;

18.22 in pursuing development, States, the private sector, an other legitimate stakeholders should cooperate to promote the responsible growth of aquaculture;

18.23 strengthened regional and inter-regional cooperation should increase the efficiency and effectiveness of aquaculture development efforts; and

18.24 all parties formulating improved policies and implementing practices for aquaculture development should consider and where appropriate, build on the FAO Code of Conduct for Responsible Fisheries.

Strategy for Aquaculture Development Beyond 2000

Key elements:

1.1 Investing in people through education and training

1.2 Investing in research and development

1.3 Improving information flow and communication

1.4 Improving food security and alleviating poverty

1.5 Improving environmental sustainability

1.6 Integrating aquaculture into rural development

1.7 Investing in aquaculture development

1.8 Strengthening institutional support

1.9 Applying innovations in aquaculture

1.10 Improving culture-based fisheries and enhancements

1.11 Managing aquatic animal health

1.12 Improving nutrition in aquaculture

1.13 Applying genetics to aquaculture

1.14 Applying biotechnology

1.15 Improving food quality and safety

1.16 Promoting market development and trade

1.17 Supporting strong regional and inter-regional cooperation

2001: Environmental Code of Practice for Australian Farmers (*Australian Prawn Farmer's Association, South Brisbane, Queensland, Australia, September 2001*)

Includes:

Potential Environmental Impacts

Water Quality

Aquatic Flora and Fauna

Terrestrial Flora and Fauna

Tidal Hydrology

Groundwater

Odour

Noise

Appropriate Management Practices

Site Selection

Farm Design and Planning

Construction

Pond Management

Operational Erosion Control

Pond Effluent Management

Sediment Management

Noise

Odours

Chemical Use

Environmental Contingency Plans

Predator Management

Prawn Feed Packaging

General Domestic and Office Wastes

Energy Use

Training

2001: SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia - Responsible Aquaculture (*SEAFDEC Aquaculture Department, 2001*)

Article 9: Aquaculture Development

Article 9.1.3 (4) Given the importance of mangroves, States and regional institutions should prepare regional guidelines for the responsible use of mangroves for aquaculture. States should ensure coordination among departments, agencies, and other units that have jurisdiction and stake in mangroves.

2002: Code of Practice for Sustainable Shrimp Farming (*Bureau of Fisheries and Aquatic Resources, Philippines, July 2002*)

The Code addresses the following issues:

1. Guiding Principles for Responsible Aquaculture
2. Mangroves
3. Site Evaluation
4. Design and Construction
5. Feeds and Feed Use
6. Shrimp Health Management
7. Therapeutic Agents and Other Chemicals
8. General Pond Operations
9. Effluents and Solid Wastes
10. Community and Employee Relations

Guiding Principles for Responsible Aquaculture

Companies and individuals engaged in shrimp farming, singularly or collectively:

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5. Shall strive for continuing improvements in feed use and shall use therapeutic agents judiciously in accordance with appropriate regulations and only when needed based on common sense and best scientific judgment;

6. Shall take all reasonable measures necessary to avoid disease outbreak among culture species, between local farm sites, and across geographic areas;

7. Shall take reasonable steps to ascertain that permissible introductions of exotic species are done in a responsible and acceptable manner and in accordance with appropriate regulations;

8. Shall cooperate with others in the industry in research and technological and educational activities intended to improve the environmental compatibility of aquaculture;

9. Shall strive to benefit local economies and community life through diversification of the local economy, promotion of employment, contributions to the tax base and infrastructure, and respect for artisanal fisheries, forestry, and agriculture.

2004: Code of Conduct for the Management and Sustainable Use of Mangrove Ecosystems (World Bank, etc.)

States should

11.3 not sanction further conversation of mangroves and associated tidal flats for commercial aquaculture and should take measures to restore abandoned aquaculture sites

11.4 recognize that mangrove ecosystems are not the most suitable sites for pond construction and that responsible aquaculture in mangroves should not destroy mangroves any further

11.4a aquaculture in ponds converted from mangroves is sustainable due to potential acid sulphate soil conditions, or because it causes the irreplaceable loss of coastal habitats which are important transitional environments and critical for coastal productivity and ecological processes

11.4b stop further expansion of shrimp farming into mangrove areas because [of] severe socioeconomic problems, such as dislocation of poor coastal communities

2004: Code of Conduct for the Management and Sustainable Use of Mangrove Ecosystems (World Bank, etc.)

States should promote/require

11.5 integrated mangrove aquaculture systems which are non-destructive and small-scale, environmentally and socio economically sustainable to support livelihoods of poor communities:

- mudcrab fattening or growout in mangrove pens, cages
- fish cage/bivalve culture in mangrove waterwauys
- mixed shrimp-mangrove-crab-cockle system
- oyster rearing
- integrated mangrove fish/shrimp farms, silvofisherioes or tambarks

11.6 full and independent EIA for commercial aquaculture, including assessment of impact on mangrove ecosystem, potential negative impacts on livelihoods of local communities, recurrent environment monitoring of aquaculture operations

11.7 mangrove buffer zones in aquaculture areas to support ecological functions

2004: Code of Conduct for the Management and Sustainable Use of Mangrove Ecosystems (World Bank, etc.)

States should

11.8 ban/strictly regulate aquaculture introductions of exotic/alien species likely to disperse in mangrove waterways with unpredictable consequences

11.9 encourage development of local Codes of Conduct for coastal aquaculture

11.10 abandoned or underutilized shrimp/fish ponds should be rehabilitated back to mangroves by restoring natural hydrology for natural recolonisation and/or by planting

11.11 mitigate against potential harmful impacts on mangroves:

- habitat loss
- pollution
- associated species as fish feed
- escapees of farmed animals, including exotic species
- transfer of diseases from farmed to wild populations
- bycatch destruction
- hydrological alteration

SEAFDEC RESOLUTION AND PLAN OF ACTION

2001: Resolution on Sustainable Fisheries for Food Security for the ASEAN Region (*SEAFDEC, November 2004*)

9. Work towards the conservation and rehabilitation of aquatic habitats essential to enhancing fisheries resources;

10. Mitigate the potential impacts on the environment and biodiversity, including the spreading of aquatic animal diseases, caused by the uncontrolled introduction and transfer of non-indigenous and exotic aquatic species;

…….

12. Increase aquaculture production in a sustainable and environment-friendly manner by ensuring a stable supply of quality seeds and feeds, effectively controlling disease, promoting good farm management and transferring appropriate technology;

13. Promote aquaculture for rural development, which is compatible with the rational use of land and water resources, to increase fish supply and improve the livelihoods of rural people;

Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region (*SEAFDEC, November 2004*)

B. AQUACULTURE

1. Ensure that national policies and regulatory frameworks on aquaculture development are directed toward sustainability and avoidance of conflicts by incorporating consultations with stakeholder groups, implementing aquaculture zoning, considering social and environmental impact, and also regulating rights of access to, and use of, open water sites for mariculture.

2. Ensure production of high quality seeds on a consistent and sustainable basis by providing government support for public and private hatchery development and research, developing domesticated broodstocks and fish reproductive technologies, and promoting responsible collection and use of wild broodstock and seed.

3. Promote good farm management practices that reduce effluent pollution load and comply with relevant effluent standards through appropriate treatment.

4. Reduce the risks of negative environmental impacts, loss of biodiversity, and disease transfer by regulating the introduction and transfer of aquatic organisms in accordance with the Regional Guidelines on the Responsible Movement of Live Aquatic Animals and Plants.

5. Improve the efficient use of aquatic feeds by regulating the quality of manufactured feed and feed ingredients, providing guidelines on farm-level food conversion ratios and levels of aquaculture effluents, and supporting research into developing suitable alternative protein sources to reduce dependence on fish meal and other fish based products.

6. Improve capabilities in the diagnosis and control fish diseases within the region by developing technology and techniques for disease identification, reliable field-side diagnostics and harmonized diagnosis procedures, and establishing regional and inter-regional referral systems, including designation of reference laboratories and timely access to disease control experts within the region.

7. Formulate guidelines for the use of chemicals in aquaculture, establish quality standards and take measures to reduce or eliminate the use of harmful chemicals.

8. Build human resource capabilities for environment-friendly, healthy, wholesome and sustainable aquaculture through closer public and private sector collaboration in reseach and development, paying particular attention to the emerging need for skills in biotechnology, and effectively implementing aquaculture education and extension services.

9. Promote aquaculture as an integrated rural development activity within multiple-use of land and water resources available through inter-agency coordination in policy formulation, project planning and implementation, stakeholder consultation, extension services and technology transfer.

SEAFDEC AQD

April 1996 - SEAFDEC Council instructions for AQD

a) to conduct studies on environment-friendly shrimp culture

b) to build up expertise on mangroves

2000 - Mangrove-Friendly (Shrimp) Aquaculture Workshop, Iloilo City

- implementation of Mangrove-Friendly (Shrimp) Aquaculture Project

2001 - Mangrove Webpage (www.mangroveweb.net)

2002 - Best Management Practices for Mangrove-Friendly Shrimp Culture

2003 - Regional Seminar-Workshop on Mangrove-Friendly Shrimp Aquaculture, Bangkok

2004 - Handbook of Mangroves in the Philippines (UNESCO)

Marine Shrimp Culture Industry of Thailand
Operating Guidelines for Shrimp Farms

SIRI TOOKWINAS, SURASAK DIRAKKAIT, WARAPON PROMPOJ,
CLAUDE E. BOYD, RANDY SHAW
Department of Fisheries
Bangkok, Thailand

1. THE CODE OF CONDUCT

Introduction

The marine shrimp industry in Thailand had developed a code of conduct for its operations. This code of conduct is a set of principles and processes that provides a framework to meet the industry's goal for environmental, social, and economic responsibility. The foundation of the code of conduct is the following mission statement.

The marine shrimp farming industry in Thailand is committed to producing high quality, hygienic products in a sustainable manner that provides for environmental, social, and economic benefits for the present and future generations.

Policy statements have been formulated to outline actions that the industry will undertake to meet its commitments under the mission statement. These policy statements cover a broad range of topics, including:

Environmental protection	Public consultation
Regulatory compliance	Location
Quality and safety	Continual improvement
Efficiency	Research and development
Social responsibility	Monitoring and auditing
Education and training	International trade

The code of conduct is voluntary, but it has been signed by a wide variety of industry stakeholders. The code commits the signatories to specific actions, including the development of a series of operating guidelines and procedural manuals. These actions will aid the industry in carrying out its operations in a manner consistent with the objectives of the code of conduct.

2. Operating Guideline and Procedural Manuals

This is the first in a series of operating guidelines and procedural manuals developed for the marine shrimp culture industry of Thailand. In particular, manuals covering the following sectors of the industry have been developed:

Volume 1 - Shrimp Farms
Volume 2 - Hatcheries and Broodstock Capture
Volume 3 - Processing Facilities
Volume 4 - Feeds and Chemical Suppliers

The objective of the operating guidelines and procedural manuals is to promote consistent approach to industry operations through through establishment of good management practices or GMPs. It is anticipated that the implementation of these GMPs, will enable the industry to operate in a sustainable manner.

3. Good Management Practices

Good management practices are defined here as practices that are thought to be effective, yet practical, in eliminating or reducing environmental and social impacts. GMPs may include structural (e.g., a settling basin to remove suspended solids), biological (e.g., wetland plants to remove nutrients in effluent) or management practices (e.g., minimize use of chemicals) to solve a particular problem.

A single GMP seldom solves a problem; but a system of GMPs is normally required to prevent a particular type of farming or other activity from causing negative impacts. Therefore, for an activity such as shrimp farming, a system based on GMPs requires identification of potential impacts (environmental and social) and the implementation of GMPs to prevent or mitigate the possible impacts.

4. Potential Impacts of Shrimp Farms

The first step in developing GMPs is to identify the key impacts that need to be addressed. Shrimp farming is a comparatively new activity, but possible impacts associated with operating shrimp farms are well known and include:

- Conversion of mangrove and other coastal wetlands to ponds
- Nutrient enrichment and eutrophication of coastal waters by pond effluents
- Discharge of potentially toxic and bioaccumulative chemicals into natural ecosystems
- Sedimentation in coastal waters because of erosion from ponds and other earthen infrastructure
- Salinization of freshwater sources by pond effluents or seepage
- Reduction in biodiversity of coastal ecosystems caused by water pollution, sedimentation, and toxicity of effluents
- Introduction of non-native species or new shrimp diseases into coastal waters
- Competition with other activities for natural resources
- Land use disputes

5. Operating Guidelines and Procedures for Shrimp Farms

This manual was developed with the input from international and national experts on shrimp farming operations and was reviewed by shrimp farmers at a series of regional workshops held in Thailand in February 1999.

GMPs are promoted to eliminate or minimize the negative environmental impacts listed above. The other sections of the manual discuss general guidelines for shrimp farm operations, specific procedure for implementing these guidelines, and a series of checklists and record keeping forms for farm management.

6. Operating Guidelines

1) Site Selection for New Shrimp Farms

Proper location of a shrimp farm is important for minimizing the adverse environmental and social impacts and in maximizing production rates.

GMPs for site selection includes:

1.1 The shrimp farm owner should have clear title or right to their property or other legal land concession agreements.

1.2 All stakeholders should be involved in area zoning for shrimp farming.

1.3 The carrying capacity of an area would be determined in order to prevent too many shrimp farms in one place.

1.4 The water and soil quality should be suitable for shrimp farming and farms should be located far away from pollution sources.

1.5 Farmers should register with the appropriate government agencies.

2) General Pond Management

Good pond management helps prevent water pollution, loss of biodiversity, and other negative environmental impacts, and it will improve the efficiency of shrimp production.

GMPs for pond management include:

2.1 Good water quality should be maintained by using stocking and feeding rates that do not exceed the assimilative capacity of the culture system and by using high quality feeds and good feeding practices.

2.2 Water exchange should be reduced as much as possible.

2.3 Fertilizers, liming materials, and all other chemicals should be used in a responsible manner and only as needed.

2.4 Good shrimp health management should be used.

2.5 Aerators should be positioned and operated to minimize erosion and creation of sediment mounds in pond bottoms.

2.6 Water inlets and outlet to ponds should be screened to prevent entrance of competitors and release of culture species.

2.7 Predator control methods that do no require destruction of ecologically important species in receiving water should be used.

3) Stocking Density

Stocking density is an important consideration in shrimp farming because the amount of feed needed to culture shrimp to market size increases in direct proportion to the stocking density. As feeding rates increase, water and soil quality in ponds tends to deteriorate. Ponds with high stocking rates tend to have poorer water quality than pond stocked at moderate density. Impaired water quality stresses shrimp and reduces the efficiency with which they convert feed to shrimp flesh resulting in increased feed cost. Stress can also lead to a greater incidence of disease. Effluents from ponds with excessive stocking and feeding rates are of lower quality and have a greater potential to cause water pollution than effluents from ponds stocked at more reasonable rates.

GMPs for optimizing stocking density include:

3.1 Stocking densities should be based on anticipated survival, desired size at harvest, and carrying capacity of ponds.

3.2 The size and age of shrimp fry should be considered.

4) Feed management

Feed is the basis for high levels of shrimp production in intensive shrimp culture ponds. However, shrimp do not eat all the feed provided to them, and only a portion of the feed consumed is converted to shrimp flesh. Uneaten feed, feces, and metabolic wastes enter ponds and serve as nutrients for phytoplankton. Ammonia excreted into pond water by shrimp can reach toxic concentrations. As feeding rates increase, water quality and soil quality in ponds usually deteriorates.

Good feed quality and careful feed management are essential ingredients for efficient shrimp culture. By using high quality feeds in reasonable quantities, water and soil quality in ponds is protected. This reduces stress on shrimp, less likelihood of disease, and coverting feed more efficiently to improve the feed conversion ratio and minimize feed costs. Better water quality in ponds allows a higher quality effluent and reduces the possibility for negative environmental impacts in receiving water bodies.

GMPs for feed management include

4.1 Feed should be purchased fresh and not stored for more than one month.

4.2 Feed should be stored in cool and dry areas.

4.3 Feed management practices should be implemented to assure that shrimps consume the feed as completely as possible

4.4 Medicated feed should be used only if necessary for the control of a specific diagnosis of disease.

4.5 Cut fish should not be used as shrimp feed, but if it is, care should be take to prevent overfeeding.

4.6 Pond managers should keep careful records of daily feed application rates so that feed conversion ratio (FCR) can be assessed.

5) Shrimp Health Management

Authorities on shrimp health management recognize that stress reduction through better handling, reasonable stocking densities, good nutrition, and optimal environmental conditions in ponds can prevent most infectious and non-infectious diseases. Treatment should be undertaken only when a specific disease has been diagnosed and that this disease is treatable. Also, effective measure must be taken to minimize the spread of disease between farm stocks and natural stocks.

GMPs for shrimp health management include.

5.1 Water quality evaluation and management should be implemented to avoid stressing shrimp, but when stressful conditions are observed, shrimp should be checked of diseases.

5.2 For non-infectious disease related to pond conditions, adopt the best option for disease treatment or for correcting pond conditions.

5.3 For infectious diseases that may spread widely, isolate the pond, net harvest the remaining shrimp, and disinfect the pond before discharging the water.

6) Therapeutic Agents and Other Chemicals

There is considerable use of therapeutic agents and other chemicals in shrimp culture in Thailand. Some of the chemicals can be toxic to shrimp or accumulate in the flesh of shrimp and represent a potential hazard to the

consumer. Also, some chemicals may exist in effluents as residues and be harmful to the natural aquatic ecosystems. Reducing the use of these therapeutic agents and chemicals will not only improve environment performance but also reduce cost of operating shrimp farms. Shrimp health management should focus on disease prevention through good nutrition, sound pond management, and overall stress reduction rather than disease treatment.

GMPs for safe use of therapeutic agents and other chemicals include:

6.1 Shrimp farmers should follow reliable information regarding dosage, withdrawal period, proper use, storage, disposal, and other constraints on the use of a chemical including environmental and human safety precautions.

6.2 When potentially toxic or bioaccumulative chemicals are used in ponds, waters should not be discharged until compounds have naturally decomposed to non-toxic form.

6.3 Careful record should be maintained regarding use of chemicals in ponds.

6.4 Store therapeutants in a cool place and in a secure manner where they will be inaccessible to unauthorized personnel, children, and animals. Dispose of unused compounds by methods that prevent environmental contamination.

6.5 Drug, antibiotic, and other chemical treatments should be done in accordance with recommended practices and comply with all national and international regulations.

7) Effluent and Solid Waste Management

Pond effluents often contain elevated concentrations of nutrients, biochemical oxygen demand, suspended solids, and possibly other potential pollutants. Pond management GMPs outlined previously can help improve effluent quality and reduce effluent volume. Effluent quality can be further improved by adjusting the discharge infrastructure and by the timing and manner of final discharge. Shrimp farms also generate solid wastes that should be disposed of in a manner that does not damage aquatic or terrestrial ecosystems.

GMPs for effluent and solid waste management include:

7.1 Canals and embankments should be maintained in a manner to reduce erosion of above water portions.

7.2 Minimize water exchange by adopting approrpiate technologies.

7.3 Use efficient fertilization and feeding practices to promote natural primary productivity while minimizing nutrient inputs.

7.4 Store and use fuels (e.g. diesel oil, gasoline, kerosene, etc.), feeds, and other products in a responsible manner to avoid accidental spills that could contaminate water. An emergency plan should be made for containing accidental spills

7.5 The effluent should be treated before discharging, complying with existing standards.

7.6 Ponds should be drained in a manner that would minimize resuspension of sediment and prevent excessive water velocities in canals and at effluent outfalls.

7.7 Design outfalls so that no significant impacts of effluents on natural water occur beyond the mixing zone.

7.8 Shrimp pond effluents should not be discharged into freshwater areas or onto agricultural land.

7.9 Sediment from ponds, canals, or settling basins should be put back into areas that were eroded, used as earthfill, or disposed in some other environmentally-responsible way.

7.10 Sanitary facilities for disposal of human wastes and other health facilities should be provided.

7.11 Garbage and other farm wastes should be managed by acceptable methods.

7.12 Shrimp farms should comply with existing governmental regulations related to effluents and other wastes.

7.13 Managers should routinely evaluate waste management procedures and continually attempt to improve them.

8) Social Responsibility

Sometimes, conflicts arise between shrimp farmer and others who either live in the coastal zone or depend upon coastal zone resources for their livelihood. Shrimp farmers also employ people, and conflicts may arise over various employee-employer relationship. Public relations and employee welfare are complex issues, but general guidelines presented in the GMPs will be useful in enhancing the prospects of harmonious interactions among large shrimp farming companies, workers, and the local community. In Thailand there are many small shrimp farms in addition to large company-operated farms, and many of the issues related to community relations are being addressed through other sectors of the industry, such as government regulations and shrimp farming associations.

GMPs for improving community relations include:

8.1 Shrimp farmers or associations should communicate with community leaders. This is particularly important in the planning stages for new farms or expansions.

8.2 Shrimp farmers or associations should attempt to accommodate traditional uses of coastal resources and encourage mangrove replantation activities through a cooperative attitude towards established local interest and environmental stewardship.

8.3 Shrimp farmers or associations should contribute to community efforts to improve local environmental conditions, public health and safety, and education.

8.4 Local workers should be employed as possible, and they should be fairly compensated with respect to local wage scales.

8.5 Healthy and safe living and working conditions should be provided.

8.6 Shrimp farm management should have clearly-defined and posted security policies.

8.7 Employees should have a clear understanding of their duties and of company expectations regarding their performance.

9) Farmer Associations and Education

Shrimp farmers should form cooperatives or associations by region in order to exchange technology and to achieve cooperation in water use and water management. Shrimp culture techniques are also constantly improving, and it is important that shrimp operators continue to update their knowledge of sustainable farming techniques.

GMPs for farmer association and education include:

9.1 Farmer associations should be encouraged. Meetings among members should be routinely held for exchanging information on shrimp culture.

9.2 The farmers would participate in training on the various aspects of shrimp farm management, in the manner of friendly environment practices, and for law and regulation for shrimp culture industry.

9.3 The associations should promote "environmentally-friendly" practices.

10) Data collection

Data collection on the above topics and farm accounts should be properly done. Shrimp farming association should cooperate with the Department of Fisheries in the collection, organization and evaluation of data to demonstrate the adoption of GMPs and document the benefits of their use.

The Southeast Asian Fisheries Development Center (SEAFDEC), a regional treaty organization based in Bangkok, Thailand was established in December 1967 to promote fisheries development in the region. Its Member Countries are Japan, Malaysia, the Philippines, Singapore, Thailand, Brunei Darussalam, the Socialist Republic of Vietnam, Union of Myanmar, Indonesia Cambodia and Lao Peoples Democratic Republic. The Council of Directors who represents SEAFDEC Member Countries is the policy-making body of the organization.

SEAFDEC conducts research on appropriate fisheries technologies, trains fisheries and aquaculture technicians, and disseminates fisheries and aquaculture technologies. Four departments were established to pursue these objectives

The Training Department (TD) in Samut Prakan, Thailand (1967) for marine capture fisheries training
The Marine Fisheries Research Department (MFRD) in Singapore (1967) for fishery post-harvest technology
The Aquaculture Department (AQD) in Tigbauan, Iloilo, Philippines (1973) for aquaculture research and development
The Marine Fishery Resources Development and Management Department (MFRDMD) in Kuala Terengganu, Malaysia (1992) for the development and management of marine fishery resources in the exclusive economic zones (EEZs) of SEAFDEC Member Countries

SEAFDEC/AQD is mandated to

Promote and undertake aquaculture research that is relevant and appropriate for the region
Develop human resources for the region
Disseminate and exchange information on aquaculture

The Aquaculture Department (AQD) maintains four stations in the Philippines: in Iloilo Province, the Tigbauan Main Station and the Dumangas Brackishwater Substation; in Guimaras, the Igang Marine Substation; and in Rizal, the Binangonan Freshwater Station.

Tigbauan Main Station

Dumangas Brackishwater Substation

Igang Marine Substation

Binangonan Freshwater Station

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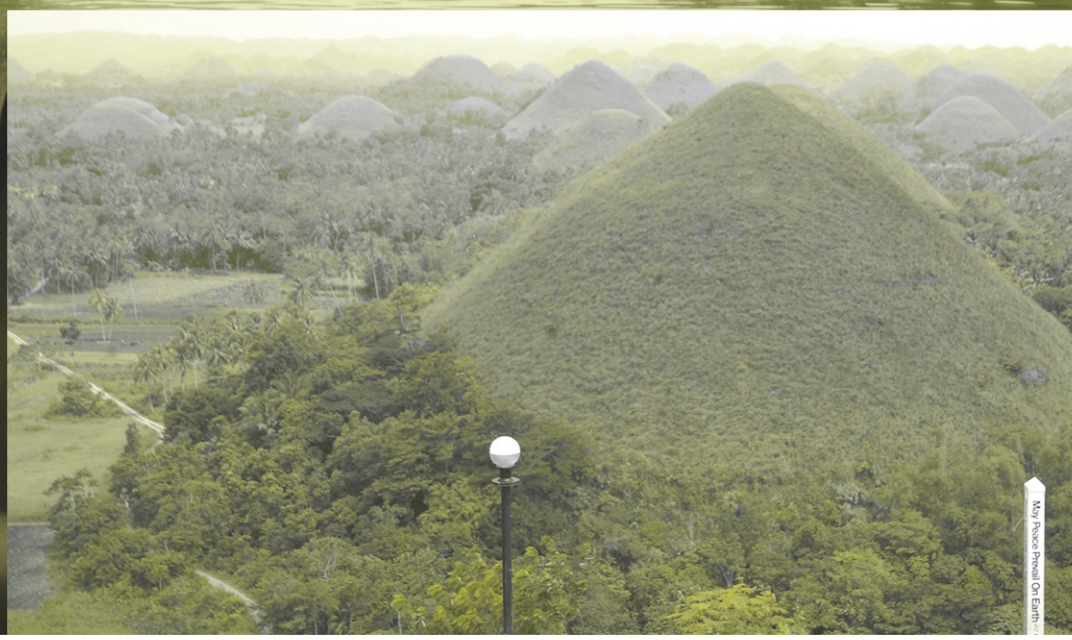

The ASEAN-SEAFDEC Fisheries Consultative Group (FCG) was organized by ASEAN and SEAFDEC in March 1999 to (a) identify important regional and international fisheries issues; (2) provide technical assistance and inputs to ASEAN for formulation and implementation of common policies; (3) assist the Member Countries in formulating common stand and positions on regional and international fishery issues; and (4) develop and implement collaborative programs. The FCG comprises the Chairman and representatives of the ASEAN Working Group of Fisheries (WGFi), the SEAFDEC Secretary-General and his representatives, and the SEAFDEC Department Chiefs with the WGFi Chairman and SEAFDEC Secretary-General as Co-Chairpersons.

Included in the first four projects implemented through the FCG collaborative mechanism, is the Promotion of Mangrove-Friendly Aquaculture in Southeast Asian Countries with the SEAFDEC/AQD as the Lead Department for SEAFDEC and Thailand as the Lead Country for the ASEAN.

SEAFDEC MEMBER COUNTRIES

Also Member Countries of the ASEAN except Japan